The prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province

by
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CONTRIBUTIONS BY PRINCIPAL RESEARCHER AND FELLOW RESEARCHERS

The principal researcher (Michelle Jooste) developed the idea and the protocol. The principal researcher planned the study, undertook data collection (without a research assistant), captured the data for analyses, analysed the data with the assistance of a statistician (Prof. Daan Nel), interpreted the data and drafted the thesis. The supervisors, Dr. Sunita Potgieter and Dr. Lize Havemann-Nel, provided input at all stages and revised the protocol and thesis. The thesis was edited for language and grammar by Amanda Matthee (Appendix K) (BA, Dipl Translation, BA Hons, MA, Stellenboch)

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Abstract

Background: Nutrition plays an important role in optimal athletic performance as "strength-and-power athletes" like rugby players would go to great lengths to increase their impact in this competitive environment. As a result, additional nutritional strategies are adopted. However, the potential adverse effects of such strategies on their health and the impact of these strategies on moral development are unclear. Healthcare professionals are concerned about the performance-enhancing supplements that young athletes are using. **Research methodology:** This cross-sectional study design used a self-administered questionnaire which consisted of specific questions to determine the prevalence and knowledge of and reasons for carbohydrate, protein, creatine and glutamine use among adolescent rugby players. Participants consisted of 189 rugby players from four League A and six League B rugby schools in the Western Cape, including 18 of their coaches. **Results:** The majority of players used carbohydrates (92%) followed by protein (79%) while only 37% of the players reported using creatine and glutamine. The prevalence of protein and glutamine use among League A players was significantly higher compared to League B players (90% vs. 69%, $p<0.001$ and 59% vs. 17%, $p<0.001$ for protein and glutamine respectively). The overall knowledge scores were poor (43%) with League A players performing significantly better than League B players (48% vs. 39%, $p<0.001$). Knowledge regarding the role of glutamine supplementation in particular was very poor. The majority of players indicated that they need education regarding supplementation and that they have not consulted a dietitian on diet and supplement use. The main reported reason for using carbohydrate supplements was to reduce fatigue/increase energy (46%) followed by an increase in muscle mass/strength (29%). Protein is reportedly consumed firstly to increase muscle mass/strength (72%) and secondly to enhance muscle recovery (24%). Creatine is predominantly used to increase muscle mass/strength while glutamine is reportedly used to enhance muscle recovery. The main source of supplement information is the coach (28%), followed by the trainer (19%) and the supplement representative (16%). Only a few of the players were aware of the amount of carbohydrates (4%), protein (22%), creatine (13%) and glutamine (4%) supplements they consumed on a daily or weekly basis with the exception of the 29% of League B players who were aware of the dose of protein they were consuming. **Discussion:** The majority of the rugby players in this study used CHO, followed by protein supplements, with fewer using creatine and glutamine. It was evident from the findings of this study that knowledge about safe and appropriate supplement use is currently lacking in both League A and League B rugby schools in the Western Cape. The main reasons

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why these rugby players use supplements are to increase energy or reduce fatigue, to increase muscle mass and to assist with muscle recovery.

According to these rugby players, carbohydrates will assist to increase energy/reduce fatigue and, similar to protein, increase muscle mass and assist with recovery. There is a misconception regarding the reasons for creatine and glutamine use. Additionally, the minority of the athletes were aware of the amount of supplements they consumed on a daily or weekly basis. Athletes looked to coaches and trainers for nutritional information, while these coaches and trainers also lacked supplement knowledge. Developing an educational programme for coaches, athletes and all involved in high school rugby, based on the latest scientific research, would benefit schools and athletes.

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Opsomming

Agtergrond: Voeding speel 'n belangrike rol in die optimale prestasie van atlete, veral sterk atlete soos rugbyspelers wat baie moeite sal doen om hul impak in hierdie mededingende omgewing te verhoog. As gevolg hiervan word bykomende voedingstrategieë in werking gestel. Die moontlike negatiewe uitwerking wat hierdie strategieë op hul gesondheid kan hê en die invloed wat dit op morele ontwikkeling het, is egter onduidelik. Gesondheidswerkers is bekommerd oor die aanvullings wat jong atlete gebruik om hul prestasie op die sportveld te verbeter. **Navorsingsmetodologie:** Dit deursneestudie-ontwerp maak gebruik van 'n self-geadministreerde vraelys wat uit spesifieke vrae bestaan om die prevalensie, kennis en redes vir die gebruik van koolhidrate, proteïen, kreatien en glutamien te bepaal. Die deelnemers het bestaan uit 189 rugbyspelers uit vier Liga A- en ses Liga B-rugbyskole in die Wes-Kaap, tesame met 18 van hul afrigters. **Resultate:** Die meeste van die spelers gebruik koolhidrate (92%) gevolg deur proteïen (79%). Slegs 37% van die spelers het aangetoon dat hulle kreatien en glutamien gebruik. Die prevalensie van proteïen- en glutamien-gebruik by Liga A-spelers is aansienlik hoër in vergelyking met Liga B-spelers (90% vs. 69%, $p<0.001$ en 59% vs. 17%, $P<0,001$ vir proteïen en glutamien onderskeidelik). Die algehele punt vir kennis van aanvullings was swak (43%) met Liga A-spelers wat aansienlik beter as Liga B-spelers vaar (48% vs. 39%, $p<0.001$). Kennis oor die rol van glutamien-aanvullings was veral baie swak. Die meerderheid van die spelers het aangedui dat hulle opleiding oor die gebruik van aanvullings nodig het en dat hulle nog nooit 'n dieetkundige oor voeding en die gebruik van aanvullings geraadpleeg het nie. Die belangrikste redes vir die gebruik van koolhidraat-aanvullings was om moegheid te verminder of energie te verhoog (46%), en om spiermassa / krag te versterk (29%). Proteïene word na bewering geneem om eerstens spiermassa / krag (72%) te verhoog en tweedens om spiere vinniger te laat herstel (24%). Kreatien word hoofsaaklik gebruik om spiermassa / krag te verhoog terwyl glutamien na bewering gebruik word om spierherstel aan te moedig. Die vernaamste bron van inligting oor aanvullings is die afrigter (28%), gevolg deur die instrukteur (19%) en die verkoopsverteenwoordiger van die aanvullings (16%). Baie min spelers was bewus van die hoeveelheid koolhidraat- (4%), proteïen- (22%), kreatien- (13%) en glutamien-aanvullings (4%) wat hulle op 'n daaglikse of weeklikse basis neem, met die uitsondering van die 29% Liga B-spelers wat bewus was van die dosis van proteïen-aanvullings wat hulle neem. **Bespreking**: Die meerderheid rugbyspelers gebruik CHO, gevolg deur proteïenaanvullings. Minder spelers gebruik kreatien en glutamien. Die resultate het duidelik getoon dat kennis oor die veilige en toepaslike gebruik van aanvullings tans in Liga A- sowel as Liga B-rugbyskole in die Wes-Kaap ontbreek. Die

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vernaamste redes waarom hierdie rugbyspelers aanvullings gebruik is om energie te verhoog / moegheid te verminder, spiermassa te verhoog en spierherstel aan te help.

Volgens hierdie rugbyspelers help koolhidrate om energie te verhoog / moegheid te verminder, en, net soos proteïen, help dit ook om spiermassa te verhoog en herstel te bespoedig. Daar is 'n wanopvatting oor die redes vir kreatien- en glutamien-gebruik. Daarby was net 'n klein groepie atlete bewus van hoeveelheid aanvullings hulle op 'n daaglikse of weeklikse basis neem. Atlete soek voedingsinligting by afrigters en instrukteurs wat self oor gebrekkige kennis van die gebruik van aanvullings beskik. Die ontwikkeling van 'n opvoedkundige program wat gerig is op afrigters, atlete en almal wat by hoërskoolrugby betrokke is, en wat op die jongste wetenskaplike navorsing gegrond is, sal skole en atlete bevoordeel.

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LIST OF ABBREVIATIONS

ACSM	American College of Sports Medicine
ATP	adenosine triphosphate
BW	body weight
CHO	Carbohydrate (C = carbon, H = hydrogen, O = ogygen)
CSC	Centre for Statistical Consultation
DRI	Dietary Reference Intake
FDA	Food and Drug Administration
GI	glycaemic index
IAAF	International Association of Athletics Federation
IOC	International Olympic Committee
ISSN	International Society of Sports Nutrition
ML	maximum likelihood
MRC	Medical Research Council
RDA	Recommended Dietary Allowance
SAIDS	South African Institute for Drug-Free Sport
SARFU	South African Rugby Football Union
SARU	South African Rugby Union
SD	Standard deviation
SDA	Sport Dietitians Australia
SOP	Standard Operating Procedure
UK	United Kingdom
URTI	upper respiratory tract infection
USA	United States of America
WADA	World Anti-Doping Agency
WHO	World Health Organization

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CHAPTER 1: LITERATURE REVIEW

1.1 INTRODUCTION

Nutrition plays an integral role in the physical performance of athletes. In today's performance-driven athletic world, supplement use is a standard part of training and it includes a wide variety of ingredients and products.[1] "Strength-and-power athletes" like rugby players are large, muscular athletes who would go to great lengths to increase lean body mass in order to improve athletic performance. Often they revert to additional nutritional strategies like excessive supplementation to reach body composition goals. Influential marketing campaigns are aimed at encouraging millions of professional and recreational athletes to use nutritional supplements, promising a host of benefits.[1]

Healthcare professionals are concerned about the performance-enhancing supplements that high school athletes are using. The potential adverse effects of such supplements on their health and the influence it can have on their moral development are unclear.[2] Sport supplements are defined by the South African Institute for Drug-Free Sport (SAIDS) as: "Sources of nutrients and/or other substances, marketed and sold as such in the field of amateur and/or professional sport, with a nutritional or physiological effect whose purpose is to supplement the normal diet, directly or indirectly alter / enhance body composition, enhance sport performance, and/or assist with recovery following sporting activity."[3]

According to Kreider et al.,[4] an ergogenic aid is "any training technique, mechanical device, nutritional practice, pharmacological method, or psychological technique that can improve exercise performance capacity and/or enhance training adaptations". The term ergogenic can encompass a variety of supplements and sporting techniques aimed at ultimately improving an athlete's body composition and performance. As a result of the wide scope of the term, a variety of nutritional and physical practices aimed at improving performance or recovery could be regarded as ergogenic aids.[4] This habit of using supplements excessively could become costly, is potentially unsafe and is not always necessary. The promoted benefits of these substances are frequently based on little or no scientific research.[1]

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The aim of this study was to determine the prevalence and knowledge of, as well as reasons for, carbohydrate, protein, creatine and glutamine supplement usage among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa. Figure 1.1 outlines the literature review motivating this investigation.

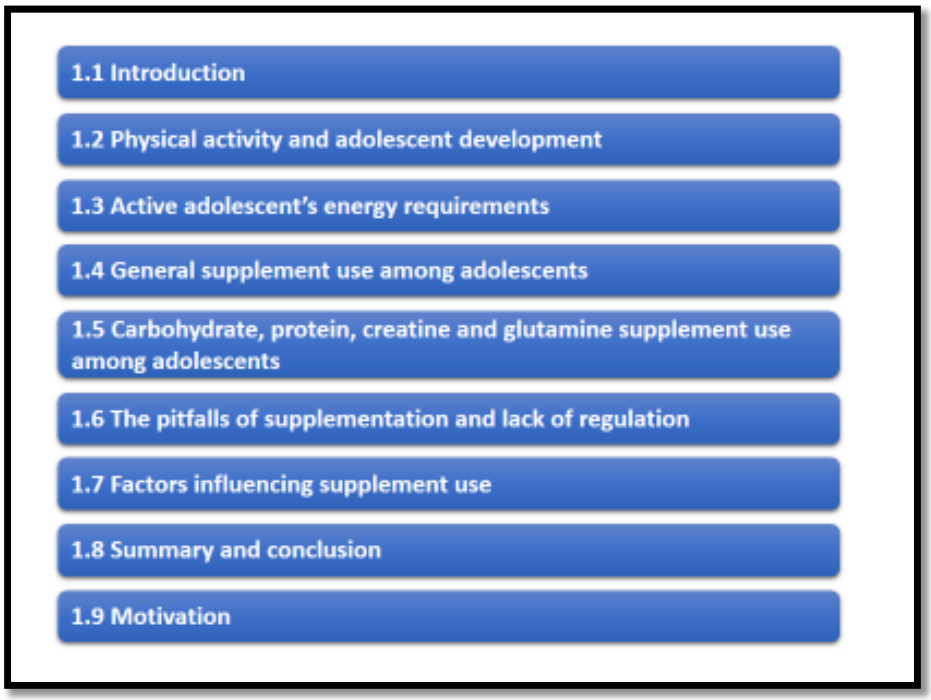

Figure 1.1: Literature review

1.2 PHYSICAL ACTIVITY AND ADOLESCENT DEVELOPMENT

1.2.1 Defining adolescence and physical activity

A competitive adolescent athlete is defined by Desbrow et al.[5] as "an adolescent aged between 12 and 18 years who demonstrates gifts/talents in the physical, physiological, or movement domains which may indicate future potential in high performance sport. This athlete may be engaged in sustained practice through high training volumes which may lead to the achievement of a high performance benchmark." This definition includes the adolescent athletes who took part in the present study as League A and League B first team rugby players. This definition does not include adolescent athletes who compete professionally on a national or international level or who compete against adults.[5]

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Physical activity is a key component in promoting lifelong, positive, healthy behaviour in children and adolescents. Physical activity is defined by Kohl et al.[6] as "any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level" while exercise refers to "planned, structured, and repetitive bodily movement done specifically to improve or maintain one or more components of physical fitness. Exercise is considered a subset of physical activity."[6]

The next section will elaborate on the benefits and concerns of physical activity for adolescents.

1.2.2 Benefits of physical activity

The primary reason for encouraging physical activity during childhood is the hope that the habit would become part of these children's lifestyle and continue into adulthood. Although activity for children and adolescents is recommended, sufficient research on the effects of physical activity on adipose tissue in children and adolescents is lacking.[6] Additionally, high school sport provides many benefits to athletes that include social interaction, establishing self-identity and developing self-esteem.[7]

These health behaviours are influenced by various factors. For example, parents appear to have a strong influence on health habits. Parents who support healthy behaviour and model healthy practices have shown to have a significant influence on their children's behaviour. In addition to parental influences, peer pressure and other role modelling have been shown to have an impact on adolescent behaviour and choices. These influences on adolescent health behaviours will be deliberated upon later in the literature study.[6]

1.2.3 Nutritional concerns about active adolescents

Physical activity is encouraged in children and adolescents. Ideally, physical activity should be a positive experience and the behaviour should become a habit that continues throughout adulthood. Adolescents and children are starting to compete at a younger age, and meeting their energy demand is critical for growth, health, body mass maintenance, daily physical activity and training. Insufficient energy intake could lead to delayed growth and maturation, reduced bone density and eating disorders. It is recommended that young athletes follow an appropriate dietary intake to ensure that they participate fully and safely in athletics.[8]

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It is important to note that regular physical activity is recommended in adolescents as it improves their fitness levels, assists in weight control, has psycological benefits and improves overall health. Unfortunately, with the increased levels of competitiveness and pressure, adolescents turn to nutritional supplements to gain a competitive edge. The lack of up-to-date information on safe supplement use and enthusiastic marketing can influence adolescent athletes, coaches and parents to trust unhealthy and unsafe nutritional supplements.[4, 7]

1.3 THE ENERGY REQUIREMENTS OF ACTIVE ADOLESCENTS

1.3.1 Energy requirements

Adolescents have unique energy requirements to meet the demands of their growth and development needs as well as competitive sports and training needs. Adolescents are experiencing a time of change and physical development which includes body composition changes, hormonal and metabolic variations and maturing organ systems. Additionally, the adolescent period also includes emotional, sexual and social maturation. During this time, adolescents establish how they view themselves, their relationship with food and their sporting performances.[7]

Sport Dietitians Australia (SDA) formulated a position statement on the nutritional needs of adolescent athletes which emphasises the importance of eating food for long-term health. Ultimately, the SDA concluded that adolescent nutritional needs should be met with food first.[5] To establish active adolescents' overall energy requirements, it is important to include their growth and developmental needs as well as their physical activity and training needs. The challenge in determining adolescent athletes' requirements can be ascribed to the metabolic changes and variables of each individual adolescent.[7]

Optimal nutritional meal plans for adolescents are largely determined by their stage of development. According to the Guideline for Adolescent Nutrition Services[7] the exact energy needs for adolescent athletes have not been determined. Firstly, it is important to differentiate between active adults and active adolescents. This shows the importance of research to establish the exact adolescent energy requirements. The energy requirements for active adults are between 50 and 80 Kcal/kg/day for moderate levels of intense training (two to three hours per day, five to six times per week), like first team adult rugby players.[9]

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The average intake recommended for active young athletes is an additional 1500 to 2000 Kcal/day over and above their Recommended Dietary Allowance (RDA). This is illustrated in Table 1.1. [7]

Table 1.1 Recommended calorie (Kcal) intake for adolescents[7]

Males	**Calorie (Kcal)**
Age (years)	**Kcal/day**
11-14	2500
15-18	3000
19-24	2900

To meet the nutritional needs of an active adolescent the diet should consist of an estimated 55% CHO, 12 to15% protein and 25 to 30% fat.[7]

1.3.2 Nutritional intake

Carbohydrates (CHO) are an effective source of energy as it releases energy within training muscles up to three times faster compared to energy generated from fat. The dietary reference intake (DRI) for adolescents is the best estimate of daily nutrient requirements. These recommendations are based on chronological age categories and not individual assessments or individual development. A total of 130g of carbohydrates per day is recommended for males between the ages of 14 and 18 years.[7] This does not take into account the increased energy expenditure of physical activity of a competitive adolescent athlete.

The CHO needs of active adolescents are based on body weight and intensity of activity. In addition to optimal CHO intake, athletes can also make use of the optimal timing of CHO meals, snacks and convenience supplements such as sport drinks, gels and bars.[7, 8] This will be discussed later in the literature study as optimal CHO intake assists with the ergogenic benefits of CHO.

Protein plays a key role in the adolescent's diet as it builds, maintains and repairs muscle and other body tissue. The DRI recommends 52g of protein per day for adolescents between the ages of 14 and 16 years of age.[7] Protein also assists with the production of haemoglobin, enzymes, antibodies and hormones. However, athletes should be taught that excess protein intake, over and above the recommended amounts for active adolescents, will not improve these functions or produce larger muscles.[7]

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Rather, the excess protein will be used as energy or converted to body fat. Building muscles require sufficient amounts of protein, energy and nutrients complemented by strength training. Optimal protein supplementation for active adolescents will be discussed later in this chapter.[7] Fat also provides energy for exercise.[8] It is recommended that athletes consume 20 to 30% of their calories from fat sources. Fat is an essential fuel for light to moderate exercise, including metabolic fuel for energy during prolonged aerobic training.[7, 8]

Optimal nutrition is an important factor in improving the physical experience for athletes, as it will supply them with more energy for daily activities and exercise as compared to following a poor diet.[8] Therefore, dietary assessment is needed to ensure sufficient nutrition, optimal growth and development. Additionally, adolescents who participate in intense exercise and training have increased nutritional needs that should be met by diet and, when needed, supplementation. The dietary assessment should ensure adequate intake of macronutrients, especially carbohydrates and protein.[7]

1.4 GENERAL SUPPLEMENT USE AMONG ADOLESCENTS

1.4.1 Prevalence of adolescent supplement use

It has been observed that the prevalence of dietary supplement usage is increasing among the adolescent athlete population. This increase in usage is linked to specific motivation to enhance performance and the perceived efficacy and consequences of such supplements.[10] Establishing the real prevalence of supplement use is complicated as a result of the various definitions of supplements. Changes are taking place as the popularity of supplement use increases, while changes in regulation govern the manufacturing and distribution of supplements in the major markets.[11]

According to a review published by Calfee et al.,[12] supplement use has increased among young athletes.[12] This is not surprising given societal influences and the “win at all costs” mentality.[2]

1.4.2 Risks of supplement use

There are psycological and metobolic differences in the way adults and adolescents absorb and excrete dietary supplements. Studies show that the use of certain supplements may be safe and effective for adults while having unpredictable and adverse effects on younger population groups.[10]

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No amount of supplementation can make up for an inadequate diet. Over the years, various studies have reviewed the efficacy of certain performance-enhancing supplements, but few investigated the impact of these supplements on adolescent athletes. Additionally, adolescents do not respond to the danger warnings and risks associated with the irresponsible use of supplements, especially if these supplements are marketed to enhance and immediately augment sport performance.[12] High school years are a vulnerable time for all adolescents, and the increased prevalence of supplement use is associated with these adolescents' awareness of their own body image and associated changes.[13] In addition, the use of nutritional supplements have not consistantly shown a competitive advantage other than the placebo effect, or resulting from the treatment of a nutritional deficiency.[14]

Furthermore, the risks associated with the use of supplements must be compared to the potential rewards. However, nutrition education is needed to make this an informed choice. The American Academy of Paediatrics' policy statement on the use of performance-enhancing substances does not support the use of ergogenic aids, including various dietary supplements, by children and adolescents. Additionally, they support any and all efforts to eradicate the use of supplements among children and adolescents.[2]

Ignoring potential risks, forceful advertising is focused on high school, college and recreational athletes, who are all impatient for anabolic-steroid like gains through dietary means.[1] The use of dietary supplements could also be a gateway to illegal steroid use in the future.[15] The gateway hypothesis states that adolescent substance use progresses through several developmental stages during which supplement use could lead to serious illegal drug use.[15, 16] This increases when non-users are encouraged to use dietary supplements where they could also gain access to using elicit appearance-enhancing and performance-enhancing supplements.[15] An article published by Bell et al.[14] shows that a total of 68% (N=333) male and female adolescents, between the ages of 13 and 19 years, from Canada are potential users of supplements that may be of limited usefulness to them. Considering the increased popularity of supplement use, it is important to explore the reasons why adolescent athletes use supplements.

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1.4.3 Adolescent supplement self-treatment

Increasingly, adolescents are taking control of their own supplement use by means of self-treatment. Additionally, adolescents are less likely to be intimidated by threats of future harm and health risks, especially when marketing practices advertise supplements providing instant benefits.[13]

Therefore, it is important for healthcare workers to be aware of adolescent self-care practices and behaviours. Adolescents should also be encouraged to discuss the use of these supplements with their parents and healthcare providers. Furthermore, adolescents believe that doctors disapprove of supplementation, which may cause adolescents to withhold important information from healthcare workers.[13]

Another reason for the increase in supplementation is the ease of using convenient supplements. Meal replacement powders, ready-to-drink supplements, energy gels and energy bars are some of the forms of readily available supplements that focus on providing CHO and protein. Currently, convenience supplements represent 50% to 75% of business sales, which shows the need for easy-to-consume products.[4] These supplements have a purpose in meeting dietary needs, especially in providing CHO and protein for athletes who have time constraints and who struggle to meet their dietary needs through diet alone.[4] The benefits of the specific supplements investigated will be discussed in the literature review.

For athletes, convenience supplements are a better choice than nutrient-poor fast food.[4] Popular supplements used by adolescent rugby players include carbohydrates, protein, creatine and glutamine supplementation.[7, 10, 17] Each of these supplements will be discussed in detail in the subsequent sections.

1.5 CARBOHYDRATE, PROTEIN, CREATINE AND GLUTAMINE SUPPLEMENT USE AMONG ADOLESCENTS

1.5.1 Carbohydrate supplementation

In this section, current research and recommendations on CHO supplementation will be discussed.

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CHO provides energy for muscles, allowing athletes to train effectively, perform well and recover more quickly.[9] Since adolescents are still growing, their habitual diet should include CHO in the form of wholesome food, irrespective of their physical ability. Wholesome food will not only provide CHO, but will also contribute to the intake of vitamins, minerals and dietary fibre. Active adolescents require additional carbohydrates, whether it is in the form of CHO-rich foods (e.g. bread, rice, pasta or potatoes) or in the form CHO-containing supplements (e.g. energy dense foods and sports drinks).[3] The use of refined carbohydrates like sport drinks, gels and bars during training and competitions could be useful.[17]

CHO is classified as a performance enhancement macronutrient supplement. According to the International Society of Sport Nutrition (ISSN),[4] CHO is categorised as a Level 1 supplement which is regarded as "apparently effective and generally safe". Supplements that fall in this category are regarded as "supplements that help people meet general caloric needs and/or the majority of research studies in relevant populations show is effective and safe."[4] According to *A practical guide to the use of nutritional supplements in South Africa*[18], CHO is classified as a Group A nutritional supplement. The definition of a Group A supplement is "supplements and sports foods that provide a performance benefit in sport-specific and individual-specific situations or provide a useful and timely source of energy and nutrients in an athlete's diet or are of medical/ therapeutic benefit". More specifically, CHO powders and gels, sports energy bars and sport drinks are listed as Group A supplements.[18]

The CHO requirement for adolescents is based on the amount of CHO they need to provide sufficient glucose for brain metabolism, but it does not take into account the muscle needs for glycogen replenishment. Children metabolise CHO differently; they are not fully developed in glycolytic capacity and make use of different nutrient oxidation routes than adults.[19] A limited amount of carbohydrates is stored in the liver and muscles as glycogen. This stored energy should be replaced once it has been used, otherwise it will have an effect on the adolescent athlete's endurance and athletic performance.[7]

CHO is an important dietary component required to ensure health and maximum intensity training and performance. There is a strong agreement of the ergogenic benefits of carbohydrate use before, during and after training sessions for competitions to improve performance and recovery.[4] Adolescent athletes should eat a light meal approximately one to two hours prior to a competition or training session, a snack after 30 minutes of activity and

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again two hours afterwards and a complete meal four to five hours afterwards.[4, 9] Eating a sufficient amount of CHO during this time would assist active athletes to maintain optimal blood glucose levels, provide sufficient energy and restore glycogen in the muscles after the training or event. These requirements can be met by making use of convenient and safe supplements like high-carbohydrate sport drinks, gels and bars.[7, 9]

Moreover, counting CHO is easier than to determine the percentage of kilojoules in the CHO. As seen in the Guidelines for Adolescent Nutrition Services[7] and in Table 1.2, the recommended ranges for moderate to heavy training for adolescent athletes are 5-8g/kg based on the adolescent athletes' weight and level of training intensity. The recommendations for adolescents on a moderate to heavy training programme do not differ significantly from those for active adults.

Table 1.2: Daily ranges for carbohydrates based on weight and level of intensity[7]

Intensity of activity	Carbohydrate (g/kg)
None / light training	3-5g/kg
Moderate / heavy training	5-8g/kg
Pre-event (24 to 48 hours)	8-9g/kg
Post-event (within 2 to 3 hours)	1.7g/kg

Sport drinks are seen as one of the most popular and supposedly "sport-enhancing" supplements used by adolescent athletes. This is true even though the role of CHO loading in paediatric sport is most likely insignificant. Studies show that these drinks have a positive effect on young athletes' recovery, but no clear effect on their athletic performance. However, it should be noted that athletes who partake in intense competitions or high-endurance events in hot temperatures for prolonged periods could make use of sport drinks. Therefore, the use of supplements like Energade can be regarded as appropriate at certain intervals and as part of a balanced meal plan. [17, 19]

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Research on adult athletes has shown that adding additional energy in the athlete's diet increases muscle mass. Athletes "bulk up" by using weight-gain powders that add extra calories to the diet and that are high in CHO and protein. Adding an extra 500 to 1000 calories per day in combination with resistance training will enhance weight gain. However, increased weight could consist of muscle and fat mass.[4] Therefore, increased calories in the diet should be monitored and regularly adapted to suit the energy requirements of the athlete.[7]

Even though sport drinks are appropriate during intense physical activity, they are not recommended as regular drinks during rest periods as excess sugar can lead to weight gain and other health-related consequences.[17, 19] There is also a concern that sport drinks could cause childhood obesity and dental problems.[17] Protein, like CHO, is the other regularly used macro-nutrient to optimise athletic performance. Protein will be discussed in the following section.

1.5.2 Protein supplementation

In this section, current research on protein supplementation in adolescents will be discussed.

Athletes require slightly more protein than non-athletes, but the main source of protein does not need to be supplemental. While studies do indicate that protein supplements are effective, there is no evidence that the ingestion of protein supplements is superior to protein-containing food in the regulation of muscle protein synthesis.[9, 20] Protein supplements are available to the public in multiple forms including shakes, pills, powders and amino acids.[14]

The Duvenage et al.[21] study showed that 40% of the 198 under-16 national-level South African rugby players believe that the quality of protein in supplements is better than the protein found in food. Relying solely on supplementation as a source of protein is ill-advised.[21] The protein found in food should still be the primary source of protein in an adolescent athlete's diet. As a result, protein supplements should not be the only source of protein in adolescent athletes' diets.[5] However, protein supplements do have a practical role provided that the supplement is of a high quality and that it is only used to complement dietary protein intake. Additionally, athletes who have an inadequate diet or who have restrictive energy intakes can benefit from safe protein supplementation.[22]

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According to the ISSN,[4] protein is categorised as a muscle-building supplement. Similar to CHO, it is classified as "apparently effective and generally safe".[4] Similar to CHO, protein supplementation is a Group A supplement which includes recovery formulas, skim milk powder, sport drinks and liquid meal replacements.[18]

As stated previously, protein is utilised by the body to build, maintain and repair muscle and other body tissues. Replacing CHO with high-protein meals after training will risk optimal muscle glycogen repair and it could weaken future performance. Young athletes should eat protein from a variety of natural plant and animal sources, such as skinless chicken, fish, egg whites and milk.[7] When increased nutrients are required or when athletes cannot cope with the increased demands of sport and academic obligations then nutritional supplements can be considered to meet their protein requirements. This should be done with the help of a sports dietitian as the supplement industry is poorly regulated and some supplements may contain banned or illegal substances.[23]

The most popular reasons why high school athletes consume protein supplements are to improve their speed, agility and strength.[24] According to the Guidelines for Adolescent Nutrition Services, the daily protein requirement for adolescents is 0.9g/kg BW/d.[7] The official protein requirements for adolescents in this group have not been evaluated as young athletes may need more protein. It is suggested in these guidelines that adolescent athletes who are beginning with a training programme should consume 1.0 to 1.5 g/kg BW/d. Also, adolescent endurance athletes may require between 1.2 and 1.4 g/kg BW/d. Adolescent athletes who training and compete intensely, like first team rugby players, should consume protein amounts of 1.2 to 1.4g/kg BW/d.[7]

Individual athlete evaluations are very important as individual factors could also influence protein needs. Nevertheless, protein recommendations for adolescent athletes should never exceed 1.5g/kg BW/d until the completion of their growth spurt.[7]

Adolescent athletes should know that consuming too much protein from food or supplemental sources can lead to health risks which include dehydration, increased urinary calcium loss and weight gain. Additionally, the potential adverse effects of excessive protein or amino acids include gout, gastrointestinal upset, hepatotoxicity, renal toxicity, hypercalciuria, atherosclerosis, colon cancer and impaired essential amino acid absorption.[7, 24]

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The Duellman et al.[24] study undertaken among 61 high school football players in a small Midwestern town found that the majority of the athletes were under the impression that using supplements had little or no health risks, which is a clear misconception among high school athletes. [24]

The protein supplementation that is available on the market is sold and advertised in different forms. Protein can be wholesaled as a complete protein supplements or the specific amino acids, which are the building blocks of protein, can be sold separately and has different health benefit claims. Specific amino acids like branch chain amino acids, taurine, arginine, whey, casein and glutamine are sold and marketed to promote muscle recovery and to build muscle.[17]

In addition to protein supplementation, literature has recommended the use of creatine to aid muscle adaptations to training. Creatine is a naturally occurring protein derived from amino acids (glycine and arginine). It is commonly used as a supplement, as discussed below. [3, 20]

1.5.3 Creatine supplementation

In this section, current research on creatine supplementation in adolescents will be discussed.

Creatine is one of the most popular nutritional supplements among athletes. In adult populations creatine supplementation has been reported to increase strength, fat-free mass and sprint performance.[22] These are desirable qualities in rugby and football players. The prevalence of creatine use in high school sport has been reported to be between 7% and 30% of the athletic population.[25]

According to the ISSN's[4] classification and categorisation of supplements, creatine falls in Category 1 which is "apparently effective". This classification is defined as "supplements that help people meet general caloric needs and/or the majority of research studies in relevant populations show is effective and safe".[4] According to *A practical guide to the use of nutritional supplements in South Africa*, creatine is also classified as a Group A supplement.[18]

Creatine is a naturally occurring protein that can be found in food products like meat, poultry and fish.[25, 26] This protein consists of two amino acids, namely arginine and glycine.[26] In the muscle, phosphorylated creatine serves as an available source of adenosine triphosphate (ATP). Throughout most exercises, ATP is used as an energy source in the mitochondria. During sport

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that consists of regular sprinting, the aerobic production of energy becomes deficient in meeting the ATP demand. Consequently, creatine can assist in the anaerobic production of ATP in these repeated and intense exercise sessions. Creatine supplementation has not shown to be beneficial during aerobic exercises.[26]

In the Maughan et al.[11] review of dietary supplements for athletes it was concluded that creatine's impact has been studied and evaluated in various types of exercise. This includes strength, power, single and repeated sprints and endurance that included sports like cycling, running and swimming. It is well established in studies performed on adult athletes that creatine supplementation can enhance power output during short maximal sprints. These results were also observed in multiple-sprint endurance exercise events such as football and other team sports.[11]

The dosage recommended by the literature for adults suggests a loading dose of 20g for four to six days. This is the followed by a lower dosage of 2g daily for an unspecified period.[25] Creatine remains a legal nutritional supplement for athletes to use, but it is not recommended for anyone younger than 18 years.[12]

The Smith et al.[27] study undertaken among 328 male and female high school athletes in Minnesota indicated that 75% of the adolescents who used creatine supplementation did not know how much creatine they used or what the recommended amounts were.[27] These study subjects reported adverse effects such as diarrhoea, cramps and loss of appetite.

Additionally, high school athletes from the age of 14 years acknowledged that they have used creatine supplementation.[27] It is reported that the high school athletes lack sufficient knowledge to make informed decisions regarding creatine use, as majority of the creatine users reported dosage intakes that were higher than the recommended dosage.[27]

Side effects also include gastro-intestinal distress, muscle cramping, stiffness and strains. Weight gain is one of the outcomes of creatine, but it is the result of the large nitrogen molecule's ability to draw in water.[25]

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The Food and Drug Administration (FDA) has shown concern about creatine supplementation practices and has recommended that athletes talk to a healthcare professional before using the supplement. Additionally, the safety data for creatine use in athletes aged 14 to 18 years is lacking in literature and formal studies are needed.[27] As a result of this absence of information, the American College of Sports Medicine's Position Stand stated that it does not support supplement use in under 18-year-old youths.[19] Aside from creatine, glutamine is another popular amino acid used as a supplement to enhance athletic performance.[17]

1.5.4 Glutamine supplementation

In this section, current research on glutamine supplementation in adolescents will be discussed.

The Mason et al.[28] study of 2012 investigated regular fitness and bodybuilding websites and found glutamine to be among the six most frequently advertised supplements on fitness and bodybuilding internet sites. The search included MEDLINE (2000 to August 2011).[28]

These sites assisted in marketing glutamine as "essential for serious athletes" and as increasing growth hormone levels and enhancing muscle metabolism. They also advertised glutamine as vital for optimal immune support. These marketing strategies suggested that it is impossible to obtain sufficient glutamine from food and that the body does not have sufficient glutamine during intense training sessions. The only way to get all the benefits is to buy glutamine from these websites. However, the claims made by these marketing strategies are unsubstantiated by current science.[29]

According to the ISSN's[4] classification and categorisation of supplements, glutamine falls in Category IV, which is seen as "apparently ineffective". This category is defined as "supplements that lack a sound scientific rationale and/or research has clearly shown to be ineffective".[4]

According to *A practical guide to the use of nutritional supplements in South Africa*, glutamine is classified as a Group B supplement. This group is defined as "supplements currently lacking substantial proof of beneficial effects or have no proof of beneficial effects in sportspersons. These supplements enjoy a cyclical pattern of popularity and use, but have not been proven to enhance sport performance."[18]

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Glutamine plays an important physiological role as it increases cell volume and stimulates protein and glycogen synthesis. Although glutamine is an abundant non-essential amino acid in the human body, there is no concluding evidence that supports it as a sport supplement that enhances lean body mass.[18]

The average intake of glutamine from dietary protein is approximately 3 to 6g per day. This is presuming that daily protein intake is calculated at 0.8 to 1.6 grams per kilogram body mass for a 70 kilogram person. Glutamine supplements are available on the market in various forms. L-glutamine is available in tablets or capsules, or in powder form.[30]

Glutamine supplementation is seen as having the potential to prevent negative results from overtraining, resulting in uninterrupted training with increased intensity and frequency. Generally, glutamine use is seen as fairly safe, but it is not recommended for individuals with kidney problems. Evidence does state that added protein (20-30g/day) can restore depleted plasma glutamine levels in over-trained athletes. This indicates that consuming the right amount of protein is very important, but the intake of glutamine supplements is not essential. The evidence that is discussed below does not support the recommendation for athletes to use glutamine supplements.[30]

Candow et al.[31] studied the effects of oral glutamine supplementation combined with resistance training among a group of 31 young adults between the ages of 18 and 24 years. The participants were randomly selected and received glutamine or a maltodextrin placebo. After a six-week period it was reported that glutamine in resistance training had no significant effect on lean muscle mass, athletic performance and muscle protein deprivation in young athletes.[31]

In 1995, a study undertaken among 24 elite swimmers from Queensland, Australia, found that during an intense four-week training period, glutamine levels tended to increase and not decrease. No difference in glutamine levels was found among the swimmers who reported upper respiratory tract infection (URTI) versus those who did not. This study shows that plasma glutamine levels do not necessarily decrease during episodes of intense training. Additionally, the development of upper urinary tract infection (URTI) is not directly related to fluctuation in plasma glutamine concentration in over-trained athlete swimmers.[32]

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Another claim of the benefits of glutamine use states that it increases the release of growth hormones. The fact is that one hour of strenuous exercise increases the release of plasma growth hormone levels by approximately 20-fold, which shows that there is no reason for athletes to use glutamine to increase growth hormone release.[29, 30]

Evidence is not strong enough to support claims that glutamine supplementation enhances athletic performance. A double-blind study was performed among 31 young adults between the ages of 18 and 24 years in Canada. Over a six-week period they did total body resistance training of four to five sets of six to twelve repetitions at high intensities. The study found that glutamine has no effect on lean muscle mass and strength gain. Daily glutamine and placebos were given to the study population. The total muscle gain and strength in the glutamine and placebo group was the same.[31]

The evidence that proves that athletes need to buy and use glutamine supplementation is insufficient. The excitement around glutamine use is another example of how marketing can influence people's health opinions and beliefs.[29]

1.6 THE PITFALLS OF SUPPLEMENTATION AND THE LACK OF REGULATION

In the previous section, the supplements that are being investigated in this study have been discussed. In this section, the regulations that govern supplementation and the causes of positive doping tests and related risks will be discussed.

1.6.1 Regulation of the supplement industry

The supplement industry is a rapidly growing business.[20] Advertising supplements that claim to enhance the performance and output of athletes speaks directly to the needs and desires of athletes who strive be the best. In South Africa, the regulation of nutrition-related ergogenic supplements is particularly poor. Medicines in South Africa is regulated by the Medicines Control Council, unfortunately supplements do not fall under this.[18, 20] In the United States of America (USA), the Dietary Supplement Health and Education Act of 1994 allows supplement manufacturers to make claims on supplements pertaining to the effects it will have on the composition and function of the body; the only rule is not to state on the product that it could "diagnose, mitigate, treat, cure, or prevent" a certain disease. Therefore, manufacturers are allowed to make claims, valid or invalid, on their supplements.[20]

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Consequently, the lack of regulation causes supplements, which may contain prohibited substances or have been linked to increased mortality and morbidity, to be freely available on the market. This includes the South African market.[1] The use of supplements has led to a disturbing increase in reported health effects and positive doping tests.[3] This will be elaborated upon in the next section. Hence, in the USA, supplement products can be promoted and sold with incorrect labelling, false claims and with no scientific evidence of efficacy and safety.[1, 3]

Concerns regarding supplement use are alarming, and athletes should be aware of the potential physical and emotional harm that can be caused by supplementation. As a result of the unregulated supplement industry, a variety of supplements of questionable value, ingredients and quality is available on the market internationally. Unregulated supplement use could be costly and potentially harmful. Additionally, the claimed benefits of supplements are often based on little or non-existing scientific evidence. In addition, many supplements contain prohibited substances that are banned in professional sports and that could be linked to increased morbidity and mortality.[1]

Manufacturers of dietary supplements are not regulated or forced to prove the safety, efficacy, purity or potency of their products. This leads to major safety concerns regarding label discrepancies, contamination, lack of standard quality and potential health risks.[10] The World Health Organization (WHO) suggests that most cases of positive drug tests are not caused by the supplement itself, but by contaminants like growth hormones and anabolic agents in the supplement.[1, 10]

The increase in the number of positive drug tests, also among rugby players, has drawn the attention of various sporting bodies around the world. This includes the South African Institute for Drug-Free Sport (SAIDS)[33], South African Rugby Football Union (SARFU), International Olympic Committee (IOC) and International Association of Athletics Federation (IAAF).[3] In South Africa the SAIDS currently performs an average of 10 drug tests every day to help regulate and lower doping among athletes.[33] The front-runners in the fight against doping in sport include the World Anti-Doping Agency (WADA).[34] Athletes should be aware that the information on product labels does not guarantee safety.[1]

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WADA has published a list of prohibited substances that is updated regularly.[34] However, innocent ingestion of prohibited substances is not an acceptable excuse, and all athletes who test positive will be penalised as the sole responsibility lies with the athletes to make sure they make use of safe supplements.[18]

1.6.2 Positive doping tests and risks

Healthcare professionals can play a significant role in counselling young athletes on supplement use. Rugby players should be made aware of the potential health risks of some of these supplements and also of the different legal and illegal supplements.[2]

Van Der Merwe et al.[35] evaluated the possibility of a failed dope test through the use of contaminated supplements. One contaminated nutritional supplement capsule was given to five healthy male volunteers between the ages of 24 and 55 years. By testing their urine samples it was established that the intake of microgram amounts of prohibited substances via contaminated products could lead to positive doping tests. This could be the possible result of inadvertent doping as the athletes consumed a mildly contaminated supplement and had a positive urine test.[35]

It is stated that the ultimate responsibility in terms of legitimate supplement use lies with the athlete. The accountability rule of WADA states that the initial responsibility lies with the athlete in terms of any substance found in his/her body fluids regardless of its origin.[35] The unregulated supplement industry limits the option to guarantee safe supplement use. Therefore, the increase in positive doping tests could be the result of inadvertent doping. This is problematic as athletes easily assume that nutritional supplements are safe and trustworthy as they are readily available without prescription and are sold legally, with the promise of greater success. Positive doping tests could also be the result of deliberate doping where the athlete was aware of the prohibited status of the supplement, but continued to use the supplement. Ultimately, inadvertent or deliberate positive doping tests will be treated equally.[35]

Therefore, athletes should not substitute proper training for easy solutions claimed by supplements. The findings above emphasise the need to regulate dietary supplements, and to provide nutrition education and scientifically sound information.[1, 17] These interventions and preventative methods should be specifically targeted at adolescents.[1] Using supplements can cause health risks, and also damage elite athletes' reputations and careers should they test

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positive for a banned substance as a result of deliberate or inadvertent prohibited supplement use.[17]

1.7 FACTORS IMPACTING SUPPLEMENT USE

1.7.1 Influencial people

In general, adults are more cautious than adolescents when it comes to supplement use. Adolescents are more vulnerable and are more easily influenced by factors like peer pressure, marketing campaigns and authority figures. This could lead to an unhealthy use of supplements by adolescents.[10]

Knowledgeable coaches can play a key role in the supplement use of adolescents as a result of the influence they have on such athletes.[21] However, studies show that coaches are not prepared to impart nutritional or supplemental information to athletes.[36, 37] Several research studies have shown that coaches and trainers have the strongest influence on athletes' behaviour.[21, 36, 37] Athletes perceive coaches as knowledgeable and a valid source of information.[37, 38, 39]
Coaches have a strong influence on the lifestyle and choices that young athletes make.[38] Nutrition education should be targeted at coaches, athletes and healthcare professionals. Studies show a growing need to educate sport coaches and to focus more strongly on the training and development of sport nutrition as a field of study.[36, 37, 38, 39]

The Zinn et al.[36] study showed that coaches had a 56% nutrition knowledge score, but scored the poorest in the supplementation section with an average of 33%. Couture et al. 2015[37] showed that the most popular source of information used by coaches was the internet (55%).

Based on the need for more education among coaches and sport teams, as well as the current lack of knowledge among this group, it is important to encourage coaches and teams to secure funding and to consult with a sport dietitian to gain additional nutritional knowledge.[36, 37]
Parents, peers, famous athletes and physicians have shown to be a strong influence on the behaviour of adolescents as it relates to physical activity. Interestingly, influencial pressure from parents on child athletes may be replaced later during adolescence with the pressure they experience from their peers. Furthermore, this kind of pressure may be more common among groups of boys, rather than girls.[6] Supplement information was mostly sourced on the internet and in magazines.[40, 41]

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These sources of information thrive on sensationalism and money as reporting scientifically correct information on supplements is not their main priority. Using banned substances is unethical, hampering the health and development of plenty of athletes.[17] Athletes know that doping is cheating, yet they still use banned substances to cope with the unrealistic demands and pressures from parents, coaches and friends.[21]

Coaches and healthcare professionals should strive towards best practice and advocate the "food first" approach that has shown greater awareness among international teams.[21] A set protocol can assist in risk management and be supervised by an overseeing dietitian.[5, 21]

1.7.2 Lack of education

Studies suggest that adolescent rugby players should consult with qualified professionals regarding personalised meal plans. This will help to ensure the sustainable short- and long-term health of these rugby players.[5] This approach will also decrease unnecessary supplementation practices that could cause potential harm to the health of these athletes. Consequently, this approach will empower young athletes to take charge and to make their own informed choices regarding optimal nutrition that supports their growth and development.[42]

In 2015, Duvenhage et al.[21] showed that adolescent rugby players lacked well-rounded sport nutrition knowledge, while having a positive attitude towards supplementation. Moreover, these adolescent rugby players would use supplements irresponsibly to reach their ultimate body composition goals. Rugby players' lack of awareness of the risks involved in supplement use is a point of concern, given the current rise in doping regulations and procedures. Furthermore, adolescents continue to use supplements despite the lack of long-term safety data. The number of adolescent rugby players who use self-prescribed supplements and supplements prescribed by store salesmen and representatives are increasing significantly.

Additionally, athletes should be made aware of the hierarchy of evidence to understand the validity of scientific-based evidence. Athletes can trust research that are of good quality, effective, appropriate and feasible. Dietitians, athletes and coaches should focus on systematic reviews, randomised controlled trials, observational studies and interpretive studies. These studies have been shown to be effective, appropriate, excellent and good. Expert opinions, case studies and studies of poor methodological quality are poor and not feasible.[48] Furthermore, supplement companies and sales representatives could present studies which they state as

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'scientific evidence', but could also be of poor quality or anecdotal. Athletes should be able to identify the difference between reliable and poor research studies to understand the effectiveness and the long term safety of the supplements.[3]

A study by Heneghan et al.[45] evaluated the quality of the current evidence for sport enhancing products. Henehgan et al.[45] came to the conclusion that the current available evidence is not of sufficient quality to provide the public with effective research regarding the benefits and dangers of sport supplements. It is recommended that to improve the quality of research, a shift should be made towards focusing on using systematic review evidence to make informed decisions.

The studies discussed in this chapter show that athletes are aware of the stigma associated with doping and supplementation. Therefore, the likelihood of censored answers by respondents may negatively influence the results, even though anonymity is assured as a matter of ethics.[43]

1.8 SUMMARY AND CONCLUSION

The "food first" approach should be used when determining adolescent athletes' nutritional requirements. This will assist to maintain the short- and long-term health of athletes and to support optimal growth, development and athletic performance.[5,7]
Athletes pursue excellence in sport, but they can easily lose sight of what is safe and fair. Many supplements available on the market contain prohibited substances or have been linked to increased mortality and morbidity.[11] These findings indicate the need to regulate dietary supplements and to implement nutrition education programmes supported by scientifically sound information.[1, 17]

Coaches, parents, friends and role models have a significant influence on the health and supplement choices made by young athletes.[6, 38] Therefore, nutrition education should involve the athletes, coaches, parents and all the authority figures that impact these adolescents' lifestyle choices.[36, 37, 38, 39]

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Safe supplementation is only recommended for their convenience and for when the athlete's diet cannot provide sufficient quantities of nutrients required for the athlete's busy and active lifestyle. The assessment of the athlete's nutritional needs should preferably be done by a dietitian.[18]

The responsibility lies with the athlete to make an informed decision regarding food and supplement intake. According to the legal clause, "strict liability" means that the athlete is accountable for any substance found in his/her body fluids regardless of its origin.[18, 35]

1.9 MOTIVATION

"South Africans are rugby mad. On any given match day, men, women and children can be seen wearing rugby jerseys." These words are displayed on the South African Rugby Union (SARU) website. After soccer, rugby is the most popular sport in South Africa, with a following of close to ten million in a population of 44 million. The development and implementation of new programmes at school, club and university level is one of SARU's aims to reap the long-term benefits in the sport. According to the annual SARU 2012 report, more than R25 million was spent on the development of rugby on these platforms.[44] This will increase the interest of young rugby players and create more winning teams. South African rugby competes globally and regularly beats the top teams. The setting around adolescent sport has changed and more pressure is placed on athletes to perform.[21, 40]

Increased local and global exposure forces athletes to use supplements to cope with pressure from parents and coaches, and to obtain a competitive advantage. Adolescent athletes also have added pressure as they are offered scholarships to university if they perform well on the rugby field.[40] Adolescent sport is starting to develop into a "win-at-all-costs" environment where they will do whatever it takes to succeed. Athletes have a lack of understanding of the use of supplements, despite numerous sources of information being available to them.[38]

The marketing and selling of performance-enhancing substances has become a lucrative business, with insufficient evidence to support the health claims and performance-based claims of these substances. It is therefore impossible for young athletes to make informed choices about the risks and benefits of using these advertised supplements.[45] Coaches, dietitians and

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other medical professionals should work together to educate and assist young athletes in a holistic approach.[38] Most athletes do have access to sport dietitians, but they do not make use of them.[38] Studies on the knowledge and perceptions of young South African athletes would help physicians and dietitians to identify the common misconceptions held by these athletes. Programmes can be developed to educate them and can include members of the non-medical coaching and support teams.[38] To the best of the author's knowledge, there is a lack of published research on supplement use among adolescent rugby players in South Africa.

The lack of evidence to support the performance-enhancing and recovery claims of supplements is worrying. Most of the websites that advertise these supplements have no evidence supporting their claims. Some websites do cite studies, but most of the evidence is not suitable for critical appraisal. The role that bias plays in these studies supports the lack of quality studies as many studies are funded by supplement companies that are hoping for the positive results they are marketing.[45]

Research shows that there is a strong link between adolescent attitude towards supplements and the use of dietary supplements. Various studies have investigated the association between the prevalence of supplement usage and motives for using these substances.[38, 39, 41, 43] Unfortunately, most of these studies have been done in other countries, using university students as study participants. Only a limited number of studies have assessed supplement use among high school athletes in South Africa.

This study focuses on carbohydrate, protein, creatine and glutamine usage and knowledge among first team rugby players in the Western Cape. The adverse effects of performance-enhancing substances in young athletes are unknown and of great concern to healthcare professionals.[2, 21] This is why it is important to know to what extent young athletes are using supplements, what knowledge they have of these supplements and why they use these supplements.

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CHAPTER 2: METHODS

2.1 RESEARCH AIM

The main aim of this study was to determine the prevalence and knowledge of and reasons for carbohydrate, protein, creatine and glutamine supplement usage among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa.

2.2 RESEARCH OBJECTIVES

The specific objectives of the study were to:

- Determine the prevalence of carbohydrate, protein, creatine and glutamine use among adolescent rugby players;
- Determine the rugby players' knowledge regarding i) supplement usage and ii) effectiveness of supplements
- Determine the rugby players' motivation (influences and reasons) for the use of supplements;
- Determine the prior training, current knowledge and prescriptive behaviour of coaching staff towards their adolescent rugby players regarding supplementation;
- Compare the above-mentioned parameters between rugby players in League A versus League B high schools;
- Determine whether their knowledge of supplements impacts their use of supplements.

2.3 NULL HYPOTHESIS

a. The knowledge of adolescent male rugby players from premier league schools regarding supplementation does not influence their supplement usage.
b. There is no difference between premier A and B league rugby schools' supplement use and motivations (influences and reasons) for supplement use in the Western Cape.

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2.4 STUDY DESIGN

2.4.1 Research team

The principal researcher, who is a registered dietitian, developed the concept and protocol of this research study. The principal researcher planned the study, collected the data, captured the data for analysis, analysed the data with the assistance of a statistician (Prof Daan Nel), interpreted the data and drafted the thesis. Dr Sunita Potgieter (supervisor) and Dr Lize Havemann-Nel (co-supervisor) provided input during all stages and revised the protocol and thesis.

2.4.2 Study type

This exploratory study consisted of a cross-sectional, descriptive research design. A quantitative research methodology was employed, using ten premier rugby high schools as the research population. The planning and development (conceptual framework) of the study is presented in Figure 2.1.

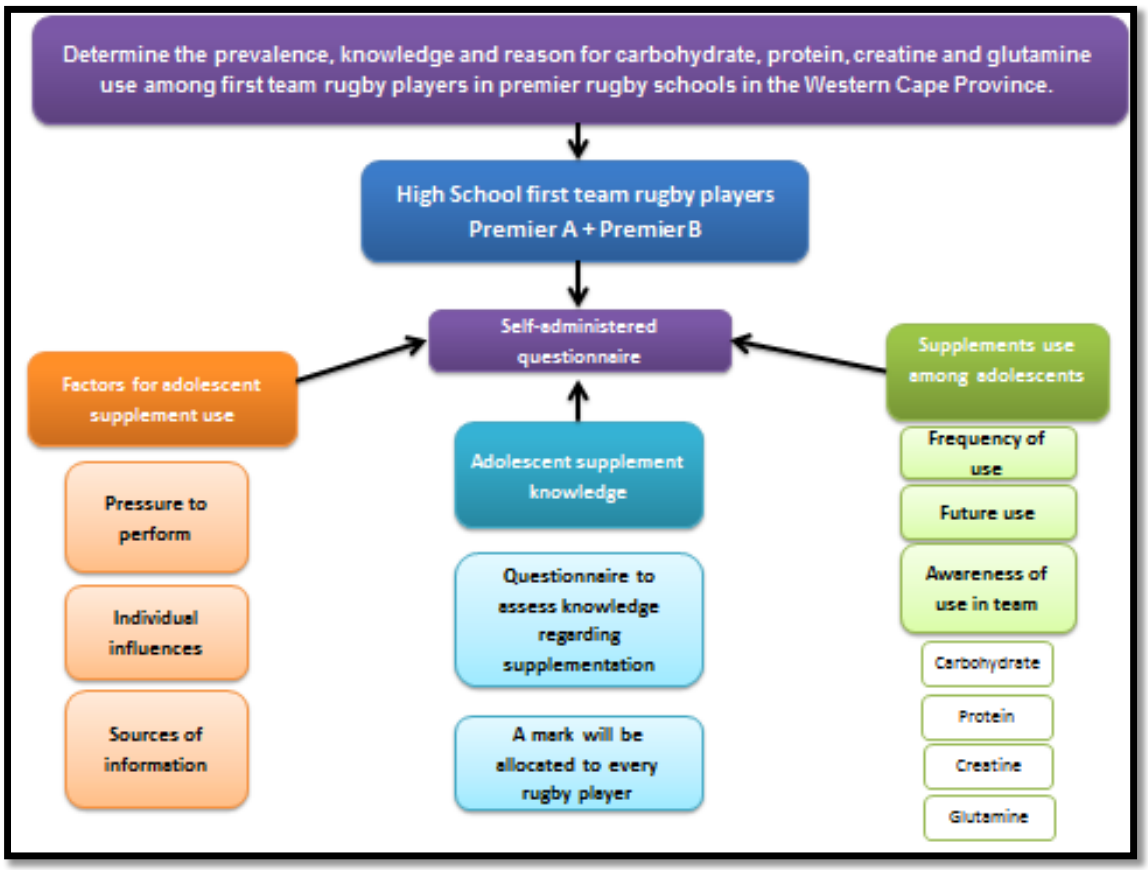

Figure 2.1: Conceptual framework of the study

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2.5 STUDY POPULATION

The study population consisted of first team high school male rugby players, including the reserve players, from the premier rugby schools in the Western Cape Province, South Africa. This study was not restricted to a specific age or ethnic group. The coaching staff of the selected schools were also included in the study.

2.5.1 Sample selection

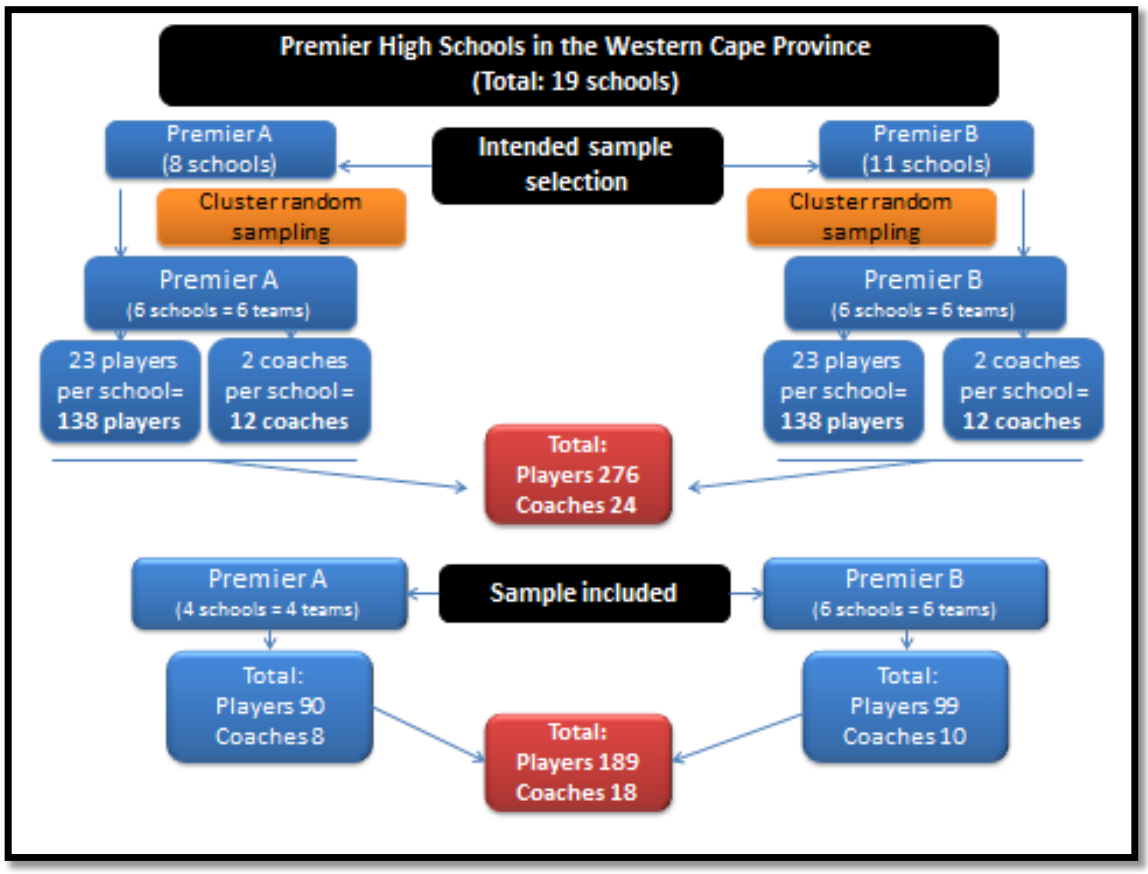

Figure 2.2: Intended sample selection and sample included

These schools were chosen by means of cluster random sampling after a list of the entire premier rugby high schools' league consisting of 19 schools was obtained from the Western Cape Premier League Schools Rugby Fixtures. The rugby fixtures of the specific League A and B schools were determined by the teams' competitive performance of the prior year. The schools from both the premier A league (eight schools) and B league (eleven schools) were selected to take part in the study. Cluster random sampling was done to select six high schools from League A and six high schools from League B. Only four of the six League A schools contacted volunteered their participation, whereas all six of the League B schools volunteered their participation, as illustrated in Figure 2.2.

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2.5.2 Power calculation

A power calculation was performed to determine the appropriate sample size that will ensure sufficient power when making comparisons between League A and League B. The intended sample was 276 rugby players or 138 players from each league (p-value = 0.05, power percentage = 90% and effect size = 0.277).

The actual sample size was 189 rugby players (90 players from League A and 99 players from League B) for which a post hoc power calculation yields p-value = 0.05, power = 90% and effect size = 0.345.

2.5.3 Response rate

The total number of adolescent rugby players invited to participate in this study was 230 (23 at each of the 10 schools). Not all those invited attended the initial session where consent forms were distributed and not all those who attended returned a completed parent consent form. As a result, 189 rugby players provided all the required consent forms. This equates to a response rate of 82%.

A total of 19 coaches were invited to participate in the study, of which 18 coaches (eight League A and ten League B) completed the consent form and the questionnaire. This equates to a response rate of 95%.

2.5.4 Description of sample

This study was conducted on a representative sample (n=189) of first team high school rugby players, including reserve players, from premier rugby schools in the Western Cape, South Africa. The selection of the participants was not restricted to a specific age or ethnic group. A total of 90 League A and 99 League B rugby players participated in the study. These rugby players were between the ages of 16 and 19 years and were chosen from the four League A and six League B schools that gave consent to take part in this study. In addition, 18 coaches from the selected schools also participated in this study and completed a separate questionnaire.

2.5.5 Inclusion and exclusion criteria for the rugby players

The criteria applied to select the rugby players participating in this study are summarised in Table 2.1.

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Table 2.1: Inclusion and exclusion criteria for the rugby players

Inclusion criteria	Exclusion criteria
• All first team rugby players and reserves from the premier A and B league rugby schools in the Western Cape • Male rugby players • The study sample was not restricted to age or ethnic group	• Rugby players who were not from the selected schools • Rugby players from schools that did not give informed consent • Rugby players who did not give informed consent • Rugby players whose parents did not give informed consent • Rugby players who were not in the first team or reserves for the first team • Rugby players who were female

2.5.6 Inclusion and exclusion criteria for the coaching staff

The criteria applied to select the coaches participating in this study are summarised in Table 2.2 below.

Table 2.2: Inclusion and exclusion criteria for the coaching staff

Inclusion criteria	Exclusion criteria
• Coaches from selected schools • Coaches who gave informed consent • Coaches who coached first team rugby players	• Coaches who were not from the selected schools • Coaches from schools that did not give informed consent • Coaches who did not give informed consent

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2.6 METHODS OF DATA COLLECTION

2.6.1 Questionnaire completed by rugby players

Data for the study was collected through the completion of a self-administered questionnaire for the rugby players and a self-administered questionnaire for the coaching staff. Data collection took place at the selected schools in an allocated classroom after school hours. The researcher was present during the completion of the questionnaire. Data collection took place over a period of two months, from beginning February to end of March. The questionnaire was developed by the researcher, and was based on the latest literature on the subject and the stated objectives. The rugby players' questionnaire comprised of applicable and specific questions to answer the identified aims and objectives of the study. The questionnaire was divided into the five sections mentioned below and included a number of closed-ended questions relevant to each section (Appendix A).

Section 1: Demographic information and training regimen

This section examined the demographic information and training regimen of each rugby player. Specific questions about their age, rugby position and years of playing rugby were asked. This section also evaluated the rugby players' training regimen by assessing the number of hours per week they spent training, as well as the intensity and type of training they do.

Section 2: Supplement usage

This section was used to determine the rugby players' supplement usage. The supplements investigated in this study included carbohydrates, protein, creatine and glutamine. The frequency of the use of each specific supplement was also determined by a closed-ended question where rugby players had to select the category that best describes their usage of the specific supplement. Example:

Carbohydrates:

Daily	4-6 x/week	1-3 x/week	1-2 x/month	Less than monthly	Never

The remaining questions in Section 2 examined their awareness of the amount of these supplements they use per week. The players' potential future supplement use was also assessed by asking them if they would use any of these supplements in the future. The awareness of the

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use of supplements among the team members was determined by asking the rugby players whether they knew of anyone in their team who used any of these supplements.

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Section 3 and 4: Influential factors and reasons for supplement

Section 3 and Section 4 of the questionnaire examined the rugby players' potential influences and reasons for supplement usage. The rugby players were asked to state where they got their supplements from, as well as the extent of the pressure they felt to use supplements in order to perform on the rugby field. This was assessed using a Likert scale to determine the amount of pressure they experienced from their school, coach/trainer, parents, friends, supplement sponsors, the media and/or rugby role models. Example:

The school:

Strongly agree	Agree	Disagree	Strongly disagree

The rugby players were also requested to select their main source of supplement information, including the individual who provided them with the most nutritional information (i.e. coach, friends, parents, trainer, pharmacist, supplement representative, dietitian or doctor) and the form of media (i.e. magazines, internet or television).

Additional information regarding influences were assessed by evaluating whether rugby players think that more education regarding supplementation is needed and whether they have discussed their diet and supplement usage with a dietitian.

The reasons for using the various supplements were also assessed by asking them why they used the specific supplements.

Section 5: Knowledge

Section 5 of the questionnaire determined the supplement knowledge of the rugby players. A total of 15 questions – including three questions each on general supplementation, protein, carbohydrates, creatine and glutamine – were included to test their knowledge. The results were analysed to determine whether supplement knowledge influenced the rugby players' supplement usage, allowing comparison between supplement users and non-users.

2.6.2 Questionnaire: Coaches

The coaches' questionnaire consisted of the following four sections (Appendix B):

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Section 1: Demographic information

This section included specific questions to determine their job title (e.g. coach, trainer) and years of coaching or training.

Section 2: Supplement promotion

This section included three questions on the promotion of supplements to their teams. Coaches/trainers were asked whether they encouraged their rugby players to use any of the specific supplements (carbohydrates, protein, creatine or glutamine) and to provide general and specific reasons for encouraging the use of these supplements. The general reasons for encouraging supplement usage among their rugby players were also assessed. Example:

If you answered **YES** to any of the above-mentioned supplements, please state why you encourage the use of these supplements. (Choose one reason.)

	To improve the team's overall performance
	To make them better rugby players
	To increase their strength/muscle mass
	To improve their health
	To make the team stronger than the other rugby teams
	Other reason (please specify):

Section 3: Nutrition training

Section 3 determined whether the coaches/trainers received any training or education regarding nutrition and supplementation. Coaches/trainers were also asked whether they thought that providing adolescent rugby players with supplements was ethical. Example:

Do you think it is **ethical** for trainers/coaches to provide adolescent rugby players with supplements?

Yes	**No**

Section 4: Knowledge

Section 4 determined the coaches' or trainers' knowledge regarding supplementation and included the same 15 knowledge questions that the rugby players had to complete.

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2.6.3 Standard Operating Procedure

A written Standard Operating Procedure (SOP) (Appendix C) was compiled by the researcher to be used as a guideline during data collection at the selected schools. A copy of the SOP was available as reference for the researcher every day during the data collection stage of the research. The SOP ensures quality control and it was followed throughout the data collection process. The researcher used this SOP as her own training. The SOP, the supervision of the researcher and the checking of the questionnaires assisted with quality control during data collection and formed part of the quality control process of the study.

2.6.4 Pilot study

The validity of the study depends on the ability to control bias and the quality of the data. The coaches'and rugby players' questionnaires was revised and evaluated by two specialists in the field of sport nutrition to ensure content and predictive validity. Changes and adaptions were made accordingly. The pilot study assisted with the face validity of the questionnaires and was conducted using a group of adolescent rugby players and their coaches similar to the sample population to evaluate understanding of the questions and the language.

The objective of the pilot study was to determine the validity and reliability of the questionnaire; to obtain data to support sample size estimation and to test the SOP for the fieldworker. The questionnaires were given to a number of rugby players to evaluate the face validity of the questionnaire to see if the questions were clear, easy flowing and not ambiguous. A group of 23 rugby players and three coaches from one of the schools were asked to complete the questionnaire. This pilot study was conducted early in February 2015. The pilot study group size was intended to be 10% of the study population, but the number of participants selected was estimated at 8.67% of the intended sample size (300 participants). At the end, the pilot study size was 12.56% of the actual sample size (207 participants). There appeared to be no ambiguity or other problems and, subsequently, there was no need to adapt or change the original questionnaire. Given the fact that no changes were made to the original questionnaire, as well as taking into account the substantial size of the group and the significant contribution this data could possibly make, the pilot group was included in the study sample.

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2.7 DATA ANALYSIS

2.7.1 Statistical analysis

Statistical analysis was completed with the assistance of a biostatistician from the Centre for Statistical Consultation (CSC), Stellenbosch University.

2.7.2 Data capturing/handling

The data of the completed questionnaires was captured on a Microsoft Excel 2010 spread sheet and organised according to each section of the questionnaire. Questions that required the participants to answer with a continuous variable (e.g. age) were captured on the data spread sheet according to the number reported. This form of data capturing also applied to questions on frequency. An example of this is the question about the rugby players' frequency of supplement usage. Numbers from 0 to 5 were used to capture the answers: "never" (0), "less than monthly" (1), "1-2 times per month" (2), "1-3 times per week" (3), "4-6 times per week" (4) and "daily" (5). A similar coding system was used to describe the pressure the rugby players experienced from different influences in their lives. This pressure was coded from 1 to 4, ranging from "strongly disagree" (1), "disagree" (2) and "agree" (3) to "strongly agree" (4). The answers to the closed-ended questions were captured with different letters representing each option the rugby players could choose. For example, Y represented a "Yes" answer while N represented if a "No" answer. This manner of coding was used as it made the interpretation of the results easier. Open-ended questions were transcribed and analysed.

Lastly, each rugby player received a score out of 100 in the knowledge section that consisted of 15 questions. This data was captured using "1" when the participant answered correctly and "0" when the participant answered incorrectly. This manner of data capturing assisted to generate the questionnaire results for each participant and for the groups. The supplement knowledge of the rugby players was then compared with their supplement usage. In addition, the rugby players' influences and reasons for supplement use were also compared with their supplement usage. Similarly, each coach also received a score out of 100 for the supplement knowledge section.

It should be noted that the different sections of the questionnaire were analysed separately and then compared with one another. Answers were compared between premier League A and

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premier League B rugby players to see if the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine supplement usage differed.

2.7.3 Computer programs

Data capturing and statistical analysis programs used included StatSoft, Statistica® (version 12) and Microsoft Excel (2014) for Windows 7®.

2.7.4 Descriptive statistics

Summary statistics will be used to describe the variables. Means will be used as the measure of central location for ordinal or continuous responses and standard deviation (SD) as indicators of spread.

2.7.5 Comparing a continuous variable with a nominal (categorical) variable

The relationship between continuous variables (like age) and nominal variables (like League A or B) was analysed using appropriate analysis of variance (ANOVA). Non-parametric tests were used if data was not normally distributed. The appropriate test in this study was the Mann-Whitney. The Mann-Whitney p-value was reported in cases where the data was not normally distributed and is indicated in the result section with an "[a]".

2.7.6 Comparing a nominal (categorical) variable with another nominal (categorical) variable

The relationship between nominal variables (like League A and B) and other nominal variables (like different sports) was analysed using the Pearson maximum-likelihood (ML) Chi-square test.

2.7.7 Comparing ordinal variables and nominal variables

To analyse the relationship between ordinal variables (like Likert scale classifications) and nominal variables (like League A and B), non-parametric ANOVA methods were used and the Mann-Whitney test p-value was interpreted. The Mann-Whitney p-value was reported in cases where the data was not normally distributed. This is indicated in the results section with an "[a]".

2.7.8 Display of results (tables/figures)

Tables are presented as the mean±SD for continuous data. The Mann-Whitney p-value was interpreted and indicated with an "[a]", with data not normally distributed or with ordinal data.

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Relevant inferential statistics are displayed below each table. In tables where the population groups differ from the indicated group sized, this is indicated with one or more "*" and the exact number of study population group is displayed at the bottom of the table.

A p-value of **p < 0.05** represents statistical significance in hypothesis testing, and 95% confidence intervals will be used to describe the estimation of unknown parameters. This is indicated in **bold** where relevant.

2.8. ETHICS AND LEGAL ASPECTS

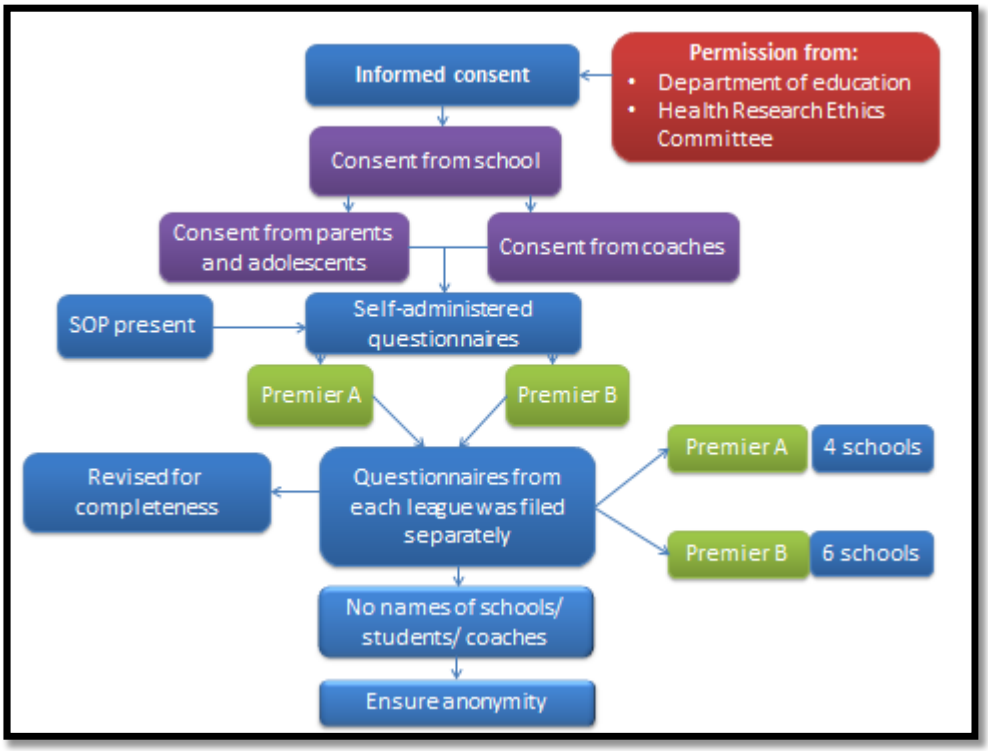

Figure 2.3: Outline of ethical aspects and quality control

2.8.1 Approval to conduct the study

The study was conducted according to the ethical principles and guidelines as stated in the Declaration of Helsinki and the South African Good Clinical Practice Guidelines. The study was submitted for ethical approval(Appendix D) to the Committee for Health Research, Faculty of Medicine and Health Sciences, Stellenbosch University (Approval number: S14/05/110). Permission was obtained from the Department of Education for the selected schools (Appendix E). Consent was also obtained from the selected schools and the parents or guardians of rugby

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players under the age of 18 years. Only rugby players who completed consent forms were included in the study. This process is illustrated in Figure 2.3.

2.8.2 Informed written consent

Obtaining permission to conduct the study and data collection was done by arranging two meetings. The purpose of the first meeting was to obtain consent from the relevant schools (Appendix F), from the parents or legal guardians (Appendix G) of these rugby players who were under the age of 18 years, and from the coaches (Appendix H). The purpose of the second meeting was to collect the written consent forms from the parents or legal guardians of the rugby players under the age of 18 years, as well as to collect the written consent forms from the rugby players (Appendix I) themselves. In addition, the second meeting was also used to distribute the paper-based questionnaires (Appendix A) for completion.

The researcher personally distributed the questionnaire at each school to the rugby players who returned a completed consent form. A different questionnaire (Appendix B) was distributed to the coaches for completion after they completed the consent form. The names of the rugby players, coaches and schools were not recorded on the questionnaires in order to ensure anonymity and confidentiality. To conclude, written consent was obtained from the schools (Appendix F), parents or legal guardians (Appendix G), coaches (Appendix H) and the players (Appendix I) of each school.

2.8.3 Anonymity and confidentiality

The consent form for the study participants was written on an understandable language level and the information on the form was also communicated verbally to the participants, coaches and the school principals prior to the signing of the consent forms at the respective schools during the first meeting. The consent form is a legally binding document that confirms that the participants' and the schools' right to anonymity and confidentiality will not be violated. Participants could choose to terminate their participation in the study at any point. The drop-out rate of the study would be recorded as it could influence the validity and reliability of the study. It should be noted that no participants terminated their participation during the study.

A method of data collection was implemented that ensured anonymity of the identity of the participants and the schools. This method of data collection ensured that the identity of the study participants and the schools was unknown to the researcher and the statistician during data analysis. Identities will also not be reported in the results of the final article of the study.

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Each participant from every school was assigned a specific number. A code was then allocated to every participant based on the rugby league that he represented and the number he received. For example, the first participant from a school was assigned the number 1 and if this participant played League A rugby, his code would be 1A. The coaches received an additional C at the end of their code. For example, coach 1 from League B would be coded 1BC. As a result, the information gathered from the participants was handled as anonymous and strictly confidential. Questionnaires and consent forms of League A and League B participants were sorted and stored in separate boxes for data capturing and analysis purposes. The boxes clearly stated premier A or premier B. Finally, the analysed data was kept on a password-protected computer to which only the researcher and the biostatistician had access.

2.8.4 Fair selection of participants

The schools for this study were chosen by the means of cluster random sampling after a list of the entire premier rugby high schools' league consisting of 19 schools was obtained from the Western Cape Premier League Schools Rugby Fixtures. Schools from both the premier A (eight schools) and B (eleven schools) leagues were selected to take part in the study. Cluster random sampling was done to select six high schools from premier A league schools and six high schools from premier B league schools. The schools were selected by writing all the schools' names on small pieces of paper, throwing the names of all the League A and League B schools in separate boxes and drawing six League A and six League B schools' names. Only four of the six League A schools contacted volunteered their participation, whereas all six of the League B schools volunteered their participation.

2.8.5 Vulnerable study population

The majority of the study participants were under the age of 18 years. Subsequently, informed consent from their parents/guardians were important as under-aged participants are considered a vulnerable study population. The study itself did not pose any threat to the health or reputation of the schools, coaches or adolescent rugby players.

2.8.6 Favourable risk-benefit ratio

This study has a favourable risk-benefit ratio as it is ethically sound and poses no harm to the study participants. The importance of this study's outcome is in proportion to the minimal risk to the study participants. Consequently, the benefit of the results of this study outweighs the risk as the study poses no threat or harm to the participants.

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2.8.7 Incentives

An educational presentation (Appendix J) was given to the study participants after data collection. The aim of the presentation was to serve as an incentive and to motivate the study participants to follow a healthy diet and becoming aware of the risks and benefits of supplement usage. The presentation educated them on doping, optimal nutrition and myths regarding supplementation.

2.8.8 Conflict of interest

There was no conflict of interest. No financial support or any other contradictory source of motivation prompted the researcher to conduct this study.

2.8.9 Permission from external stakeholders

Permission was obtained from the following stakeholders:

- Ethics Committee for Health Research, Faculty of Medicine and Health Sciences, Stellenbosch University (Approval number: S14/05/110)
- Department of Education
- Selected schools.

2.8.10 Publication

The results will be reported in an article format, using applicable graphs and tables to illustrate the analysis and results found. The article, written by the researcher, will be published in a peer-reviewed journal.

2.8.11 Community benefit

The results and findings of the study were communicated to the selected schools and coaches after all the findings had been analysed.

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CHAPTER 3: RESULTS

The results are organised according to the objectives of the study. The specific statistical tests used to determine each of the findings are indicated at the bottom of each table or graph.

Rugby players

3.1 DEMOGRAPHIC INFORMATION

This section reported the rugby players' age, years of playing rugby, primary played rugby position, training time and intensity, training type and other sports in which they participated in.

The mean age of all the rugby players participating in this study was 17 years. Furthermore, the rugby players were asked to state the number of years that they have been playing rugby. There was a significant difference between League A and League B regarding the number of years that they have been playing rugby. This information is presented in Table 3.1.

Table 3.1: Mean age of the rugby players and years of playing rugby

Variable	Total (N=189)	League A (n=90)	League B (n=99)	p-level
Age (years)	17 (±0.71)	17 (±0.73)	17(±0.68)	p=0.139
Years of playing rugby	11 (±2.4)	11 (±1.4)	10(±2.9)	p<0.001[a]

Test: ANOVA (analysis of variance) [a]=Mann-Whitney

The rugby players' primary rugby positions are summarised in Table 3.2. The overall difference between the primary positions played by League A and League B rugby players is not significant (p=0.417).

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Table 3.2: Primary played rugby position

Position	Total (N=189)	League A (n=90)	League B (n=99)	p-level
Forwards	**60% (n=114)**	**60% (n=54)**	**61% (n=60)**	p=0.574
Flanker	19% (n=36)	13% (n=12)	24% (n=24)	**p<0.05**
Prop	17% (n=32)	19% (n=17)	15% (n=15)	p=0.724
Lock	11% (n=20)	12% (n=11)	9% (n=9)	p=0.655
Hooker	10% (n=19)	9% (n=8)	11% (n=11)	p=0.491
Number Eight	4% (n=7)	7% (n=6)	1% (n=1)	
Backs	**40% (n=75)**	**40% (n=36)**	**39% (n=39)**	p=0.729
Centre	12% (n=22)	10% (n=9)	13% (n=13)	p=0.394
Wing	11% (n=20)	11% (n=10)	10% (n=10)	p=1.000
Scrum-half	7% (n=14)	8% (n=7)	7% (n=7)	p=1.000
Fly-half	7% (n=13)	8% (n=7)	6% (n=6)	p=0.782
Full-back	3% (n=6)	3% (n=3)	3% (n=3)	p=1.000

Test: Pearson (ML Chi-square)

The rugby players were asked to rate the intensity of their training sessions on a 5-point Likert scale. According to this scale, 1 represents “low intensity”, 3 represents “moderate intensity” and 5 represents “severe intensity”. The mean intensity selected by the collective group of participants was 4, which indicated moderate to severe intensity training sessions. Moreover, the rugby players were asked how many hours per week they trained for rugby purposes, excluding competition and game time. League A trained an estimated average of 12 hours per week, whereas League B trained an average of nine hours per week. These results are shown in Table 3.3.

A total of 188 rugby players answered training time questions. The results are indicated in Table 3.3 and are referenced at the bottom of the table with “*”. Similarly, a total of 98 League B rugby players answered this question, as indicated in Table 3.3, and the results are referred to at the bottom of the table with “**”.

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Table 3.3: Training time and training intensity

Variable	Total (N=189)	League A (n=90)	League B (n=99)	p-level
Training intensity	4 (±0.6)	4(±0.5)	4(±0.6)	p=0.190[a]
Training time (hours)	10(±3.7)*	12 (±3.2)	9(±3.8)**	**p<0.001**

Test: ANOVA (analysis of variance) [a] = Mann-Whitney (ordinal data) *N=188 **n=98

The rugby players were also asked to select the main type of rugby-specific training they do. There was an overall significant difference between the training sessions of League A and League B (p<0.001). This information is summarised in Table 3.4.

Table 3.4: Type of training

Variable: Type of training	Total N=189	League A (n=90)	League B (n=99)	p-level
Resistance (%)	35% (n=66)	18% (n=16)	51% (n=50)	**p<0.001**
Ball and game plan training (%)	49% (n=93)	76% (n=68)	25% (n=25)	**p<0.001**
Endurance training (%)	4% (n=8)	3% (n=3)	5% (n=5)	p=0.257
Sprinting (%)	12% (n=22)	3% (n=3)	19% (n=19)	**p<0.001**

Test: Pearson (ML Chi-square)

The rugby players were asked to specify in what other sports they participated. There was an overall significant difference between League A and League B (p=0.027), as League A only played one other sport not specified (1%) while 14 League B players played other sports such as judo (1%), basketball (1%), golf (4%), mountain biking (1%), skateboarding (1%), soccer (6%) and other sports not specified (4%). This is illustrated in Table 3.5.

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Table 3.5: Other sport played by the rugby players

Variable	Total N=135	League A (n=68)	League B (n=67)	P-level
Athletics (%)	39% (n=52)	47% (n=32)	30% (n=20)	p=0.096
Cricket (%)	39% (n=53)	43% (n=29)	36% (n=24)	p=0.492
Tennis (%)	6% (n=8)	4% (n=3)	7% (n=5)	p=0.480
Swim (%)	5% (n=7)	4% (n=3)	6% (n=4)	p=0.705
Other (%)	11% (n=15)	1% (n=1)	10%(n=14)	**p<0.001**

Test: Pearson (ML Chi-square)

3.2 THE PREVALENCE OF CARBOHYDRATE, PROTEIN, CREATINE AND GLUTAMINE USE AMONG ADOLESCENT RUGBY PLAYERS

The first objective was to determine the type and prevalence of supplement usage among the rugby players in the study. Table 3.6 presents a summary of supplement usage among the rugby players from the respective leagues. There was a significant difference between League A and League B regarding the use of protein ($p<0.001$) and glutamine ($p<0.001$). This information is summarised in Table 3.6.

Table 3.6: Prevalence of supplement use by rugby players

Supplement	Total	League A	League B	p-level
Carbohydrate	92% (n=174/189)	94% (n=85/90)	89% (n=89/99)	p= 0.243
Protein	79% (n=149/189)	90% (n=81/90)	69% (n=68/99)	**p<0.001**
Creatine*	37% (n=70/187)	41% (n=36/88)	34% (n=34/99)	p=0.355
Glutamine*	37% (n=69/187)	59% (n=52/88)	17% (n=17/99)	**p<0.001**

Test: Pearson (ML Chi-square) *N=187

The rugby players were also asked questions to determine how frequently they used specific supplements. An overall significant difference in frequency of supplement use between League A and B was found for carbohydrate ($p<0.05$), protein ($p<0.05$), creatine ($p<0.005$) and glutamine use ($p<0.001$). The majority of rugby players indicated that they used CHO one to three times per week (39%). Protein is the most frequently used supplement with 30% of rugby players consuming protein on a daily basis. Creatine and glutamine are used less frequently with the majority of players indicating that they never use creatine (63%) or glutamine (62%). Most of those who take creatine and glutamine use these supplements up to three times per week. A significantly higher number of League B players never use protein (31% vs. 10%, $p<0.05$) and glutamine (82% vs. 40%, $p<0.05$) supplements in comparison to League A players.

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Table 3.7: Frequency of supplement use by rugby players

Carbohydrates (overall effect between League A and B is **p=0.042**)				
Frequency	**Total (n=188)**	**League A (n=89)**	**League B (n=99)**	**p-level**
Never	8% (n=15)	6% (n=5)	10% (n=10)	p=0.197
Less than monthly	3% (n=5)	0% (n=0)	5% (n=5)	**p<0.05**
1-2 times per month	12% (n=23)	11% (n=10)	13% (n=13)	p=0.532
1-3 times per week	39% (n=73)	39% (n=35)	38% (n=38)	p=0.725
4-6 times per week	15% (n=28)	13% (n=12)	16% (n=16)	p=0.450
Daily	23% (n=44)	30% (n=27)	17% (n=17)	p=0.132
Protein (overall effect between League A and B is **p=0.009**)				
Never	21% (n=40)	10% (n=9)	31% (n=31)	**p<0.001**
Less than monthly	3% (n=6)	4% (n=4)	2% (n=2)	p=0.414
1-2 times per month	4% (n=8)	4% (n=4)	4% (n=4)	p=1.000
1-3 times per week	21% (n=40)	26% (n=23)	17% (n=17)	p=0.343
4-6 times per week	20% (n=38)	19% (n=17)	21% (n=21)	p=0.516
Daily	30% (n=56)	36% (n=32)	24% (n=24)	p=0.285
Creatine (overall effect between League A and B is **p=0.004**)				
Never	63% (n=113)	58% (n=50)	65% (n=63)	p=0.221
Less than monthly	5% (n=10)	8% (n=7)	3% (n=3)	p=0.206
1-2 times per month	5% (n=9)	3% (n=3)	6% (n=6)	p=0.317
1-3 times per week	12% (n=22)	20% (n=17)	5% (n=5)	**p<0.05**
4-6 times per week	5% (n=10)	6% (n=5)	5% (n=5)	p=1.000
Daily	10% (n=19)	5% (n=4)	15% (n=15)	**p<0.05**
Glutamine (overall effect between League A and B is **p=0.000**)				
Never	62% (n=115)	40% (n=35)	82% (n=80)	**p<0.001**
Less than monthly	5% (n=10)	8% (n=7)	3% (n=3)	p=0.207
1-2 times per month	4% (n=7)	5% (n=4)	3% (n=3)	p=0.705
1-3 times per week	17% (n=32)	32% (n=28)	4% (n=4)	**p<0.001**
4-6 times per week	5% (n=10)	9% (n=8)	2% (n=2)	p=0.058
Daily	6% (n=11)	6% (n=5)	6% (n=6)	p=0.763

Test: Pearson (ML Chi-square)

The rugby players' awareness of their dosage of various supplements was determined by asking them to state the dosage of their intake per day/week. This information is shown in Table 3.8. As shown in the table below, the minority of players were aware of the dosages they were using

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with the exception of the 29% of League B players who were knowlegable regarding the dose of protein they were consuming.

Table 3.8: Knowledge of the amount of supplementation (grams/dosages) consumed per day/week

Supplement	Total	League A	League B	p-level
Carbohydrate	4% (n=7/172)	5% (n=4/84)	3% (n=3/88)	p=0.653
Protein	22% (n=32/146)	16% (n=13/80)	29% (n=19/66)	p=0.069
Creatine	13% (n=9/70)	8% (n=3/37)	18% (n=6/33)	p=0.207
Glutamine	4% (n=3/70)	2% (n=1/52)	11% (n=2/18)	p=0.127

Test: Pearson (ML Chi-square)

Questions were also asked regarding the rugby players' potential future use of carbohydrates, protein, creatine and glutamine. The statistics represent the number of players who stated "yes" to potentially using these supplements in the future. These questions were addressed to all of the rugby players, regardless of whether they reported using supplements. This information is summarised in Table 3.9.

Table 3.9: Potential future use of supplementation

Supplement	Total	League A	League B	p-level
Carbohydrates	91% (n=162/178)	92% (n=80/87)	90% (n=82/91)	p=0.197
Protein	90% (n=166/185)	93% (n=83/89)	86% (n=83/96)	p=0.265
Creatine	57% (n=104/182)	64% (n=54/85)	52% (n=50/97)	p=0.256
Glutamine	59% (n=104/177)	74% (n=63/85)	45% (n=41/92)	**p<0.001**

Test: Pearson (ML Chi-square)

Table 3.10 shows the rugby players' awareness of fellow teammates' supplement usage. The statistics represent the number of players who stated "yes" to being aware of fellow teammates' potential supplement usage.

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Table 3.10: Awareness of fellow teammates' potential supplement usage

Supplement	Total	League A	League B	p-level
Carbohydrates	97% (n=178/184)	99% (n=89/90)	95% (n=89/94)	p=0.093
Protein	97% (n=182/188)	99% (n=89/90)	95% (n=93/98)	p=0.103
Creatine	85% (n=158/186)	90% (n=80/89)	80% (n=78/97)	p=0.068
Glutamine	76% (n=141/186)	90% (n=81/90)	63% (n=60/96)	**p<0.001**

Test: Pearson (ML Chi-square)

3.3 THE RUGBY PLAYERS' KNOWLEDGE OF THE USAGE, EFFECTIVENESS AND ROLE OF SUPPLEMENTS

The second objective was to determine the rugby players' knowledge regarding supplementation.

The purpose of the knowledge questionnaire was to determine the rugby players' knowledge of CHO, protein, creatine and glutamine use, as well as general supplement labelling. The knowledge scores of the respective knowledge questions of the players who answered correctly (true vs. false vs. do not know) are summarised in Table 3.11. The overall knowledge scores were poor (43%), with League A players performing significantly better compared to League B players ($p<0.001$). Knowledge regarding the role of glutamine supplementation in particular was very poor.

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Table 3.11: Knowledge scores of rugby players on supplementation

Knowledge components	Total (N=189)	League A (n=90)	League B (n=99)	p-level
Supplement labelling				
Supplements that are stated "safe" and "tested" can still harm health or reputation (N=188)	46% (n=86)	53% (n=47)	39% (n=39)	p=0.065
Supplement labelling cannot always be trusted	56% (n=105)	68% (n=61)	44% (n=44)	**p<0.005**
Supplementing is not the only way to build muscles	92% (n=173)	90% (n=81)	93% (n=92)	p=0.470
Carbohydrate supplementation				
Carbohydrates optimise training and athletic performance	67% (n=126)	70% (n=63)	64% (n=63)	p=0.353
At least 50% of an athlete's total energy intake should consist of carbohydrates	43% (n=82)	43% (n=39)	43% (n=43)	p=0.989
Carbohydrates assist with recovery after exercise (N=188)	56% (n=106)	63% (n=56)	51% (n=50)	p=0.090
Protein supplementation				
Natural protein-containing food is superior to protein in supplements	48% (n=90)	63% (n=57)	33% (n=33)	**p<0.001**
High amounts of protein intake can be harmful (N=188)	62% (n=116)	68% (n=61)	56% (n=55)	p=0.100
Too much protein can lead to dehydration	23% (n=44)	26% (n=23)	21% (n=21)	p=0.481
Creatine supplementation				
Creatine is not proven safe for athletes younger than 18 years (N=188)	66% (n=124)	67% (n=60)	65% (n=64)	p=0.844
Muscle mass is not gained through creatine intake	13% (n=25)	13% (n=12)	13% (n=13)	p=0.967
Creatine is also found in animal protein	70% (n=132)	87% (n=78)	55% (n=54)	**p<0.001**
Glutamine supplementation				
Glutamine supplementation is not proven to help prevention of muscle breakdown	4% (n=8)	6% (n=5)	3% (n=3)	p=0.388
Glutamine does not help with recovery after training	4% (n=7)	3% (n=3)	4% (n=4)	p=0.797
Glutamine supplementation is not effective for athletes	4% (n=8)	6% (n=5)	3% (n=3)	p=0.388
Total knowledge percentage	43%	48%	39%	**p<0.001**

Test: Pearson (ML Chi-square)

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3.4 THE RUGBY PLAYERS' MOTIVATION (INFLUENCES AND REASONS) FOR SUPPLEMENT USAGE

The third objective was to explore the various individuals and factors that influence the rugby players' supplement usage.

Table 3.12 provides a summary of resources that supply supplements to players. Overall, the majority of players get their supplements from pharmacies followed by supplement stores. However, significantly more League B players get their supplements from pharmacies compared to League A players. Also, coaches and the schools' authority figures supply significantly more supplements to League A players compared to League B players. There is an overall significant effect between League A and League B suppliers ($p<0.001$).

Table 3.12: Suppliers of the rugby players' supplements

Suppliers	Total (N=188)	League A (n=90)	League B (n=98)	p-level
Pharmacy	34% (n=63)	23% (n=21)	43% (n=42)	**p<0.01**
Supplement store	32% (n=61)	29% (n=26)	36% (n=35)	p=0.250
Coach	18% (n=33)	26% (n=23)	10% (n=10)	**p<0.05**
School	11% (n=20)	19% (n=17)	3% (n=3)	**p<0.005**
Family	3% (n=6)	1% (n=1)	5% (n=5)	p=0.103
Friends	2% (n=3)	0% (n=0)	3% (n=3)	p=0.083
Doctor	1% (n=2)	2% (n=2)	0% (n=0)	p=0.157

Test: Pearson (ML Chi-square)

The rugby players were asked about the people putting pressure on them to use supplements. Overall, the pressure to use supplements were perceived to mostly come from friends or teammates, and rugby role models and the media. League B rugby players experienced significantly more pressure from friends or teammates, the media as well as rugby role models compared to League A players (Table 3.13).

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Table 3.13: Pressure experienced from various sources to use performance-enhancing supplements on the rugby field

Frequency	Total	League A	League B	p-level
School (overall effect between League A and B is p=0.665)				
Strongly disagree	19% (n=35/187)	22% (n=19/88)	16% (n=16/99)	p=0.768
Disagree	43% (n=80/187)	39% (n=34/88)	46% (n=46/99)	
Agree	35% (n=65/187)	36% (n=32/88)	33% (n=33/99)	p=0.814
Strongly agree	4% (n=7/187)	3% (n=3/88)	4% (n=4/99)	
Coach/Trainer (overall effect between League A and B is p=0.118)				
Strongly disagree	11% (n=21/187)	17% (n=15/88)	6% (n=6/99)	p=0.920
Disagree	42% (n=78/187)	40% (n=35/88)	43% (n=43/99)	
Agree	39% (n=73/187)	36% (n=32/88)	41% (n=41/99)	p=0.201
Strongly agree	8% (n=15/187)	7% (n=6/88)	9% (n=9/99)	
Parents/Family (overall effect between League A and B is p=0.412)				
Strongly disagree	28% (n=52/187)	33% (n=29/88)	23% (n=23/99)	p=0.810
Disagree	55% (n=103/187)	53% (n=47/88)	57% (n=56/99)	
Agree	14% (n=27/187)	11% (n=10/88)	17% (n=17/99)	p=0.157
Strongly agree	3% (n=5/187)	2% (n=2/88)	3% (n=3/99)	
Friends/ Teammates (overall effect between League A and B is **p<0.05)**				
Strongly disagree	10% (n=19/188)	16% (n=14/89)	5% (n=5/99)	p=0.174
Disagree	31% (n=59/188)	35% (n=31/89)	28% (n=28/99)	
Agree	46% (n=87/188)	39% (n=35/89)	53% (n=52/99)	**p<0.05**
Strongly agree	12% (n=23/188)	10% (n=9/89)	14% (n=14/99)	
Supplement sponsors (overall effect between League A and B is p=0.281)				
Strongly disagree	20% (n=37/185)	25% (n=22)	15% (n=15/97)	p=0.850
Disagree	41% (n=75/185)	40% (n=35)	41% (n=40/97)	
Agree	25% (n=47/185)	20% (n=18)	30% (n=29/97)	p=0.198
Strongly agree	14% (n=26/185)	15% (n=13)	13% (n=13/97)	
Media (overall effect between League A and B is **p<0.005)**				
Strongly disagree	14% (n=26/185)	23% (n=20)	6% (n=6/97)	p=0.140
Disagree	35% (n=64/185)	36% (n=32)	33% (n=32/97)	
Agree	34% (n=63/185)	24% (n=21)	43% (n=42/97)	**p<0.05**
Strongly agree	17% (n=32/185)	17% (n=15)	18% (n=17/97)	
Rugby role models (overall effect between League A and B is **p<0.01)**				
Strongly disagree	13% (n=23/183)	20% (n=17/87)	6% (n=6/96)	p=0.074

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Disagree	31% (n=57/183)	36% (n=31/87)	27% (n=26/96)	
Agree	38% (n=70/183)	29% (n=25/87)	47% (n=45/96)	**p<0.05**
Strongly agree	18% (n=33/183)	16% (n=14/87)	20% (n=19/96)	

Test: Pearson (ML Chi-square)

Next, the rugby players were asked from where they primarily obtained their supplementation information (p=0.001). This information is summarised in Table 3.14.

Table 3.14: The rugby players' main sources of information on supplementation

Supplement adviser	Total (N=185)	League A (N=89)	League B (N=96)	p-level
Coach	28% (n=52)	43% (n=38)	15% (n=14)	**p<0.001**
Trainer	19% (n=36)	15% (n=13)	24% (n=23)	p=0.100
Supplement rep	16% (n=29)	16% (n=14)	16% (n=15)	p=0.853
Friends	15% (n=28)	10% (n=9)	20% (n=19)	p=0.059
Pharmacist	7% (n=13)	6% (n=5)	8% (n=8)	p=0.405
Parents	6% (n=12)	2% (n=2)	10% (n=10)	**p<0.05**
Doctor	4% (n=8)	6% (n=5)	3% (n=3)	p=0.480
Dietitian	4% (n=7)	3% (n=3)	4% (n=4)	p=0.705

Test: Pearson (ML Chi-square)

The main source of supplement information is the coach, followed by the trainer and then the supplement representative. A significantly higher number of League A rugby players reported receiving their information from coaches compared to League B (p<0.001). Significantly more League B rugby players asked their parents for information on supplements compared to League A players.

In addition, the rugby players also had to indicate which media they used to source supplement information. These results are presented in Table 3.15.

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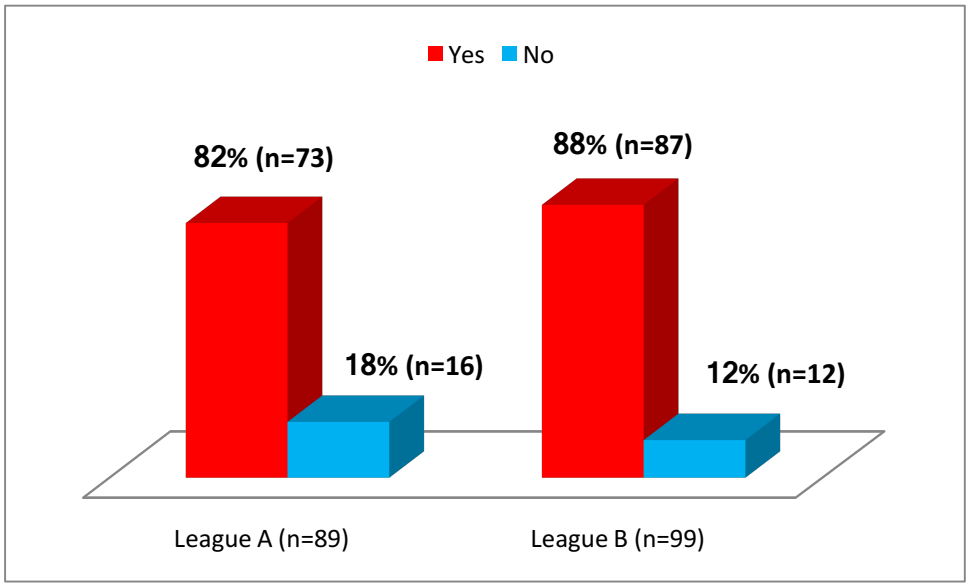
Table 3.15: Main media providing rugby players with information on supplementation

Forms of media	Total (N=183)	League A (N=86)	League B (N=97)	p-level
Internet	67% (n=122)	65% (n=56)	68% (n=66)	p=0.365
Magazines	24% (n=44)	28% (n=24)	21% (n=20)	p=0.546
Television	9% (n=16)	7% (n=6)	10% (n=10)	p=0.317
Other (not specified)	1% (n=1)	0% (n=0)	1% (n=1)	p=0.317

Test: Pearson (ML Chi-square)

According to the majority of League A and League B rugby players, they need more education on supplementation. This is illustrated in Figure 3.1.



Test: Pearson (ML Chi-square)
(N=188) (overall effect between League A and B is p=0.260)

Figure 3.1: Rugby players' opinions on whether they think they need more education on supplementation

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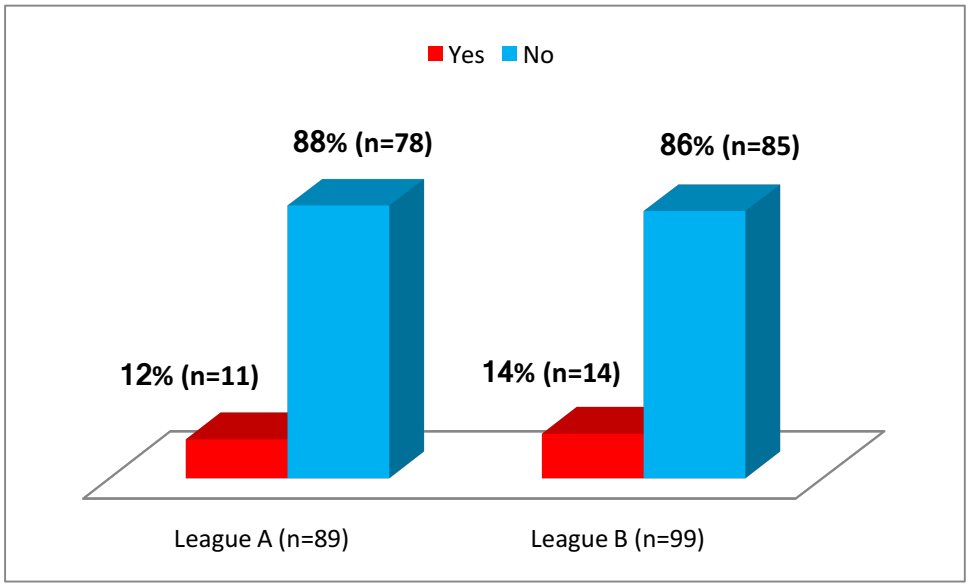
The majority of League A and League B rugby players have not consulted a dietitian regarding their diet and supplement use. This is illustrated in Figure 3.2.



Test: Pearson (ML Chi-square)
(N=188) (overall effect between League A and B is p=0.719)

Figure 3.2: Number of rugby players who have consulted a dietitian on diet and supplement use

The reasons for carbohydrate supplementation are presented in Figure 3.3, followed by the reasons for protein supplementation (Figure 3.4), creatine supplementation (Figure 3.5) and glutamine supplementation (Figure 3.6). The Pearson (ML Chi-square) test was used to determine these statistics. As seen from the figures below, the main reported reason for using CHO supplements was to reduce fatigue/increase energy followed by an increase in muscle mass/strength. Protein is reportedly consumed to increase muscle mass/strength and secondly to enhance muscle recovery. Creatine is used to predominantly increase muscle mass/strength while glutamine is reportedly used to enhance muscle recovery.

The p-value, used to specify differences between League A and B, will be shown at the bottom of each of the figures. As a result, only figures with an overall significant difference between League A and B will have the specific significant differences indicated.

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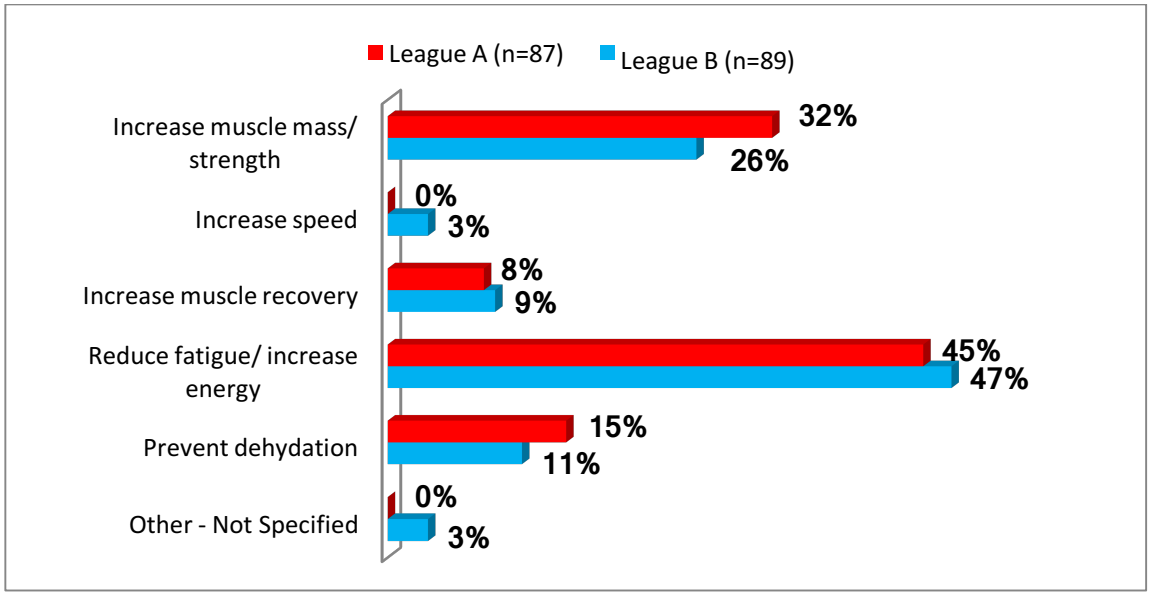
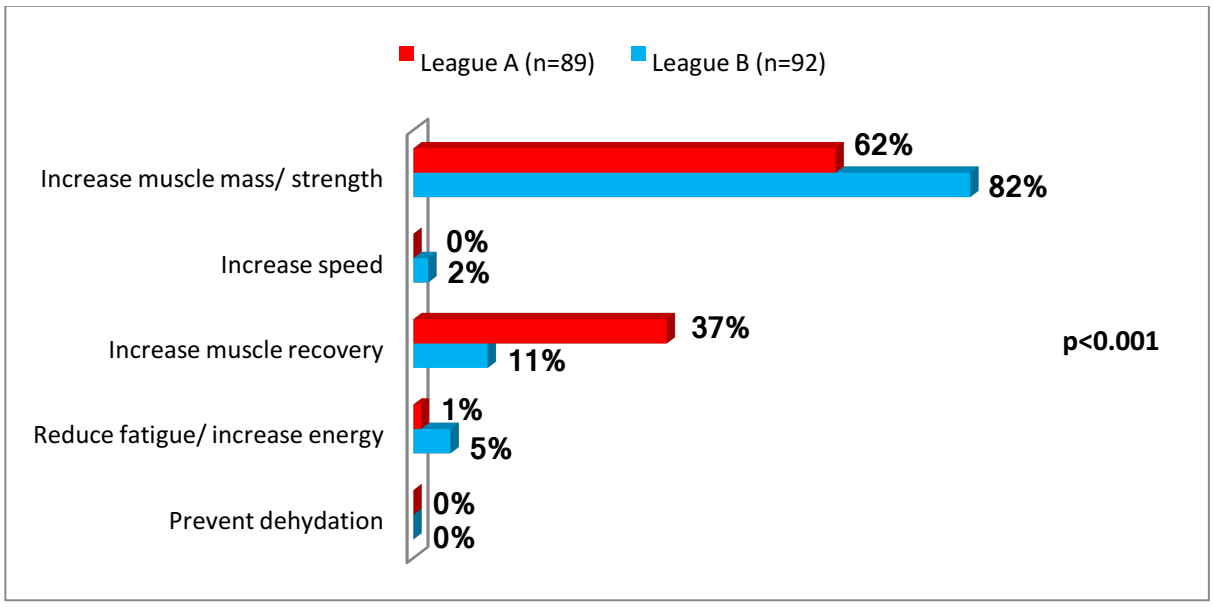


(N=176) (overall effect between League A and B is p=0.100)

Figure 3.3: Reasons for carbohydrate supplement use



(N=181) (overall effect between League A and B is p<0.001)

Figure 3.4: Reasons for protein supplement use

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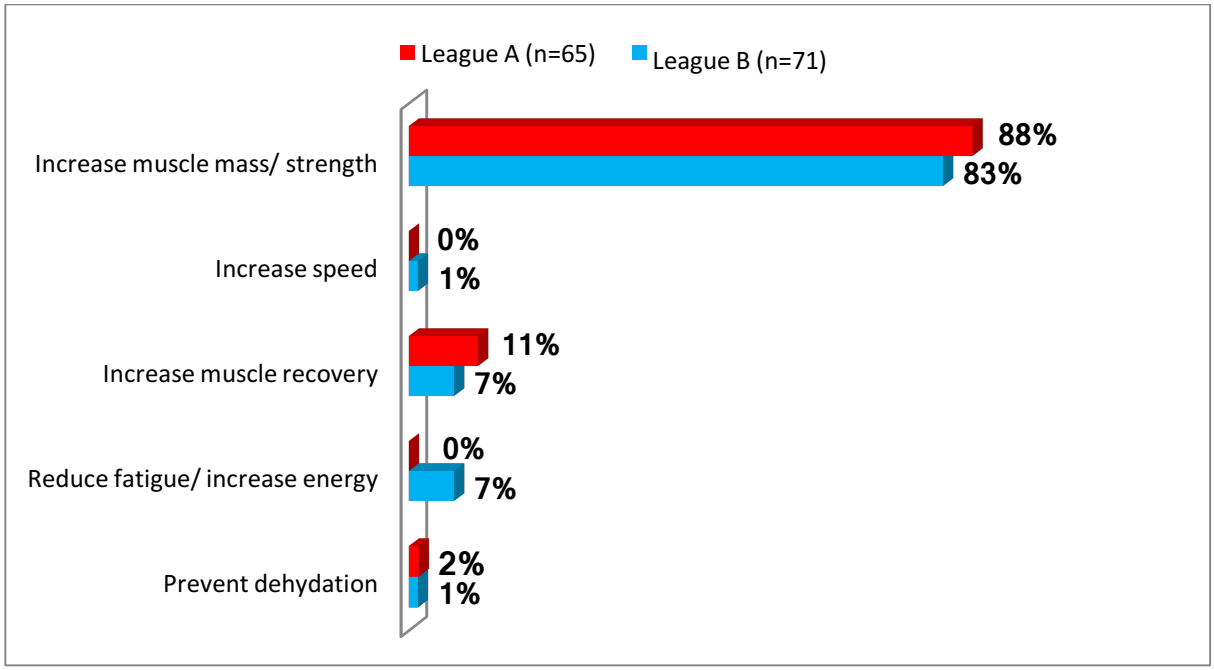
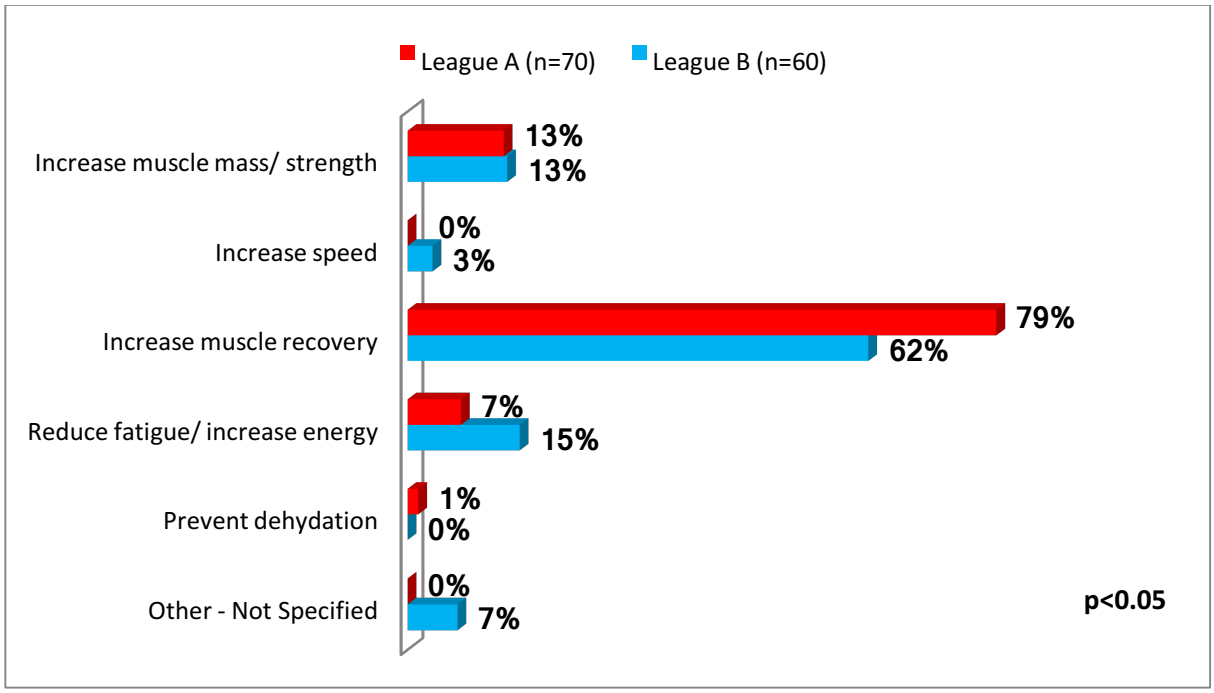


(N=139) (overall effect between League A and B is p=0.077)

Figure 3.5: Reasons for creatine supplement use



(overall effect between League A and B is p<0.05)

Figure 3.6: Reason for glutamine supplement use (N=130)

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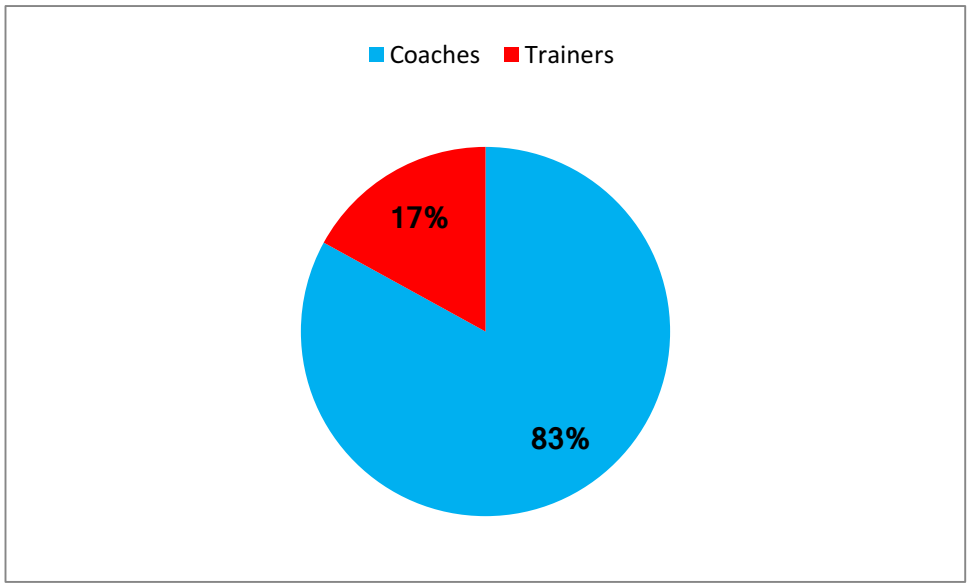
3.5 THE PRIOR TRAINING, CURRENT KNOWLEDGE AND PRESCRIPTIVE BEHAVIOUR OF COACHING STAFF TOWARDS THEIR ADOLESCENT RUGBY PLAYERS REGARDING SUPPLEMENTATION

The fourth objective was to determine the coaches' current nutritional education and knowledge regarding supplementation. Their reasons for motivating supplementation were also established.

3.5.1 Demographic information

The term "coaches" represent both the coaches and the trainers who completed the questionnaire. The distribution of coaches and trainers are illustrated in Figure 3.7.



Test: Pearson (ML Chi-square)

Figure 3.7: Distribution of coaches and trainers who took part in the study (N=18)

The coaches were asked to indicate the number of years they have been coaching in general, as well as time spent coaching rugby specifically (see Table 3.16).

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Table 3.16: Years coaching overall and years coaching rugby specifically

Variable	Total (N=18)	League A (n=8)	League B (n=10)	p-level
Years coaching	13 (±10)	8 (±6)	17 (±11)	**p<0.05**
Years coaching rugby	13 (±9)	8 (±6)	16 (±10)	p=0.063

Test: ANOVA (analysis of variance)

3.5.2 Supplement promotion

The main purpose of this section is to evaluate the coaches' encouragement of supplement usage among the rugby players. Firstly, the coaches were asked about their own supplement usage. The group size differed in terms of creatine use among the coaches. This is indicated with the "*", showing that 17 participants used creatine. In League A coaching, only seven participants used creatine, as indicated with the "**". This information is presented in Table 3.17.

Table 3.17: Prevalence of supplement use among coaches

Supplement	Total (N=18)	League A (n=8)	League B (n=10)	p-level
Carbohydrate	50% (n=9)	50% (n=4)	50% (n=5)	p=1.000
Protein	50% (n=9)	63% (n=5)	40% (n=4)	p=0.341
Creatine	12% (n=2)*	29% (n=2)**	0% (n=0)	**p<0.05**
Glutamine	22% (n=4)	50% (n=4)	0% (n=0)	**p<0.005**

Test: Pearson (ML Chi-square) *N=17 **n=7

Secondly, the coaches were asked to indicate what supplements they encouraged their rugby players to use. This information is summarised in Table 3.18.

Table 3.18: Supplements coaches encourage their rugby players to use

Supplement	Total (N=18)	League A (n=8)	League B (n=10)	p-level
Carbohydrate	89% (n=16)	88% (n=7)	90% (n=9)	p=0.867
Protein	89% (n=16)	88% (n=7)	90% (n=9)	p= 0.867
Creatine	44% (n=8)	50% (n=4)	40% (n=4)	p=0.671
Glutamine	72% (n=13)	88% (n=7)	60% (n=6)	p=0.182

Test: Pearson (ML Chi-square)

The coaches, who stated that they encouraged the use of carbohydrate, protein, creatine or glutamine supplements, were asked to report their main reasons for encouraging supplement

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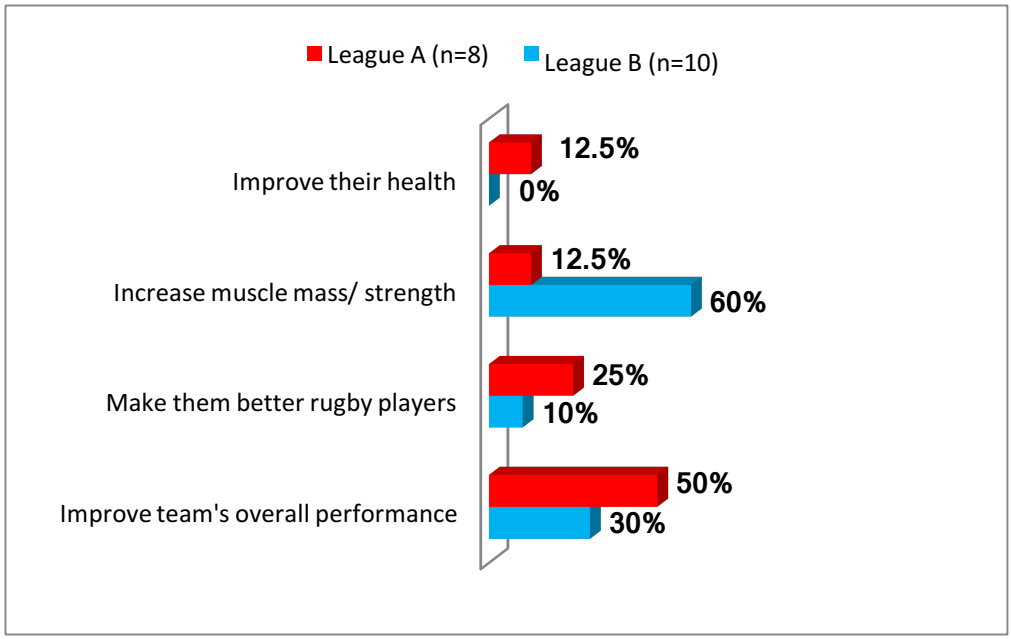
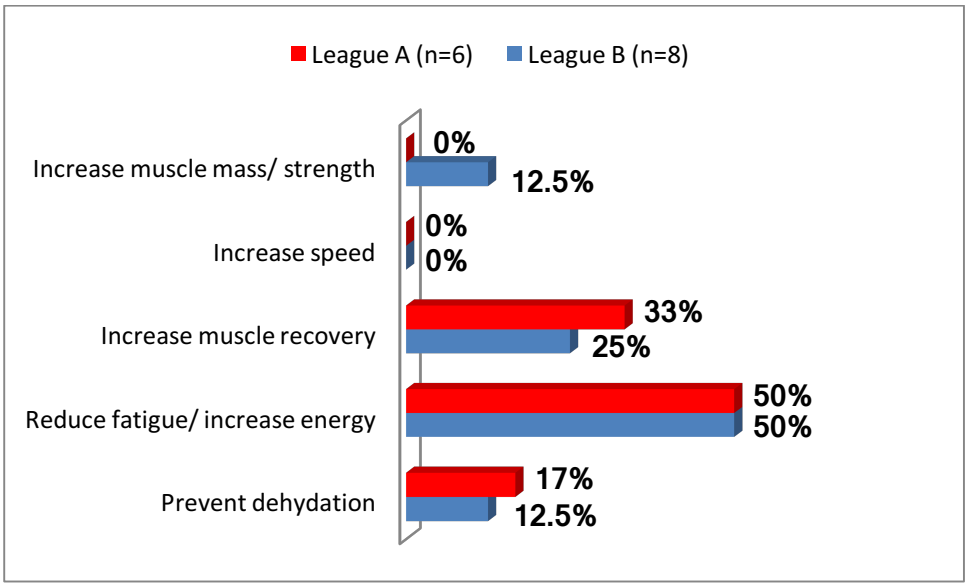
usage (see Figure 3.8). The coaches were also asked to state the specific reasons for encouraging carbohydrate supplements (Figure 3.9), protein supplements (Figure 3.10), creatine supplements (Figure 3.11) and/or glutamine (Figure 3.12) supplements. The Pearson (ML Chi-square) test was used to determine these statistics.



(N=18) Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.132)

Figure 3.8: Reasons for encouraging supplement usage



(N=14) Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.743)

Figure 3.9: Reasons coaches encourage carbohydrate supplements

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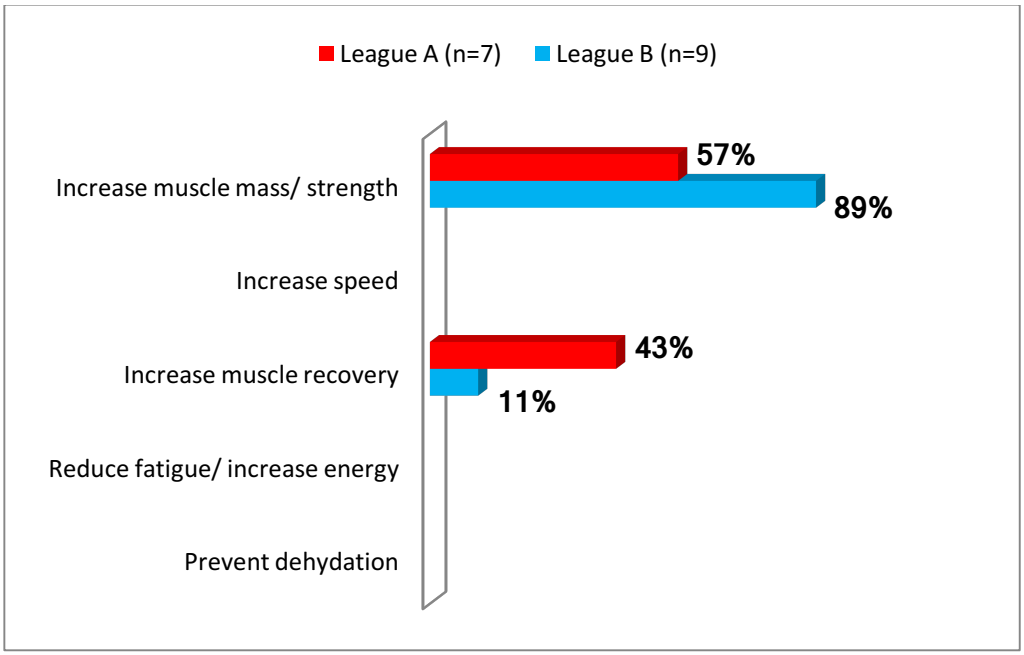
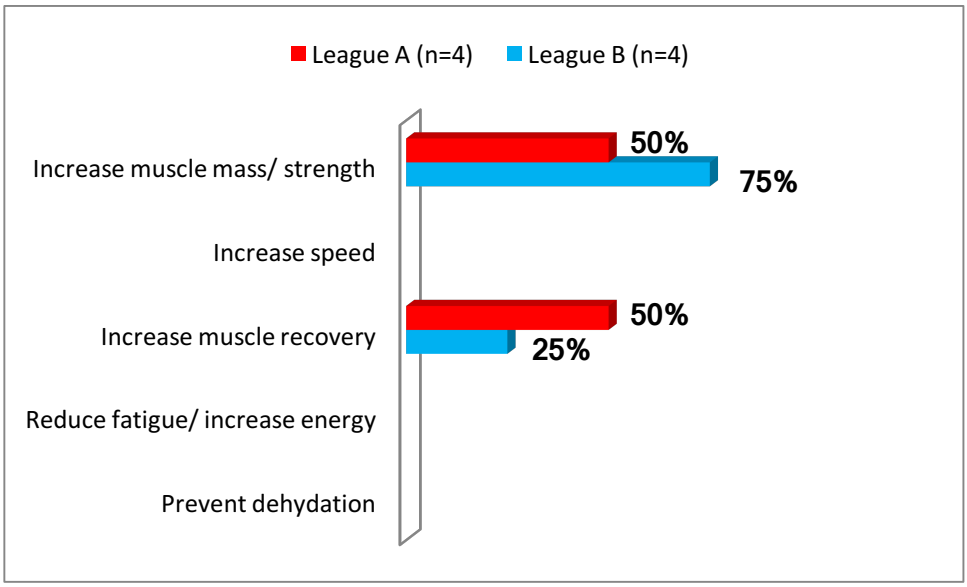


(N=16) Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.222)

Figure 3. 10: Reasons coaches encourage protein supplements



(N=8) Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.462)

Figure 3.11: Reasons coaches encourage creatine supplements

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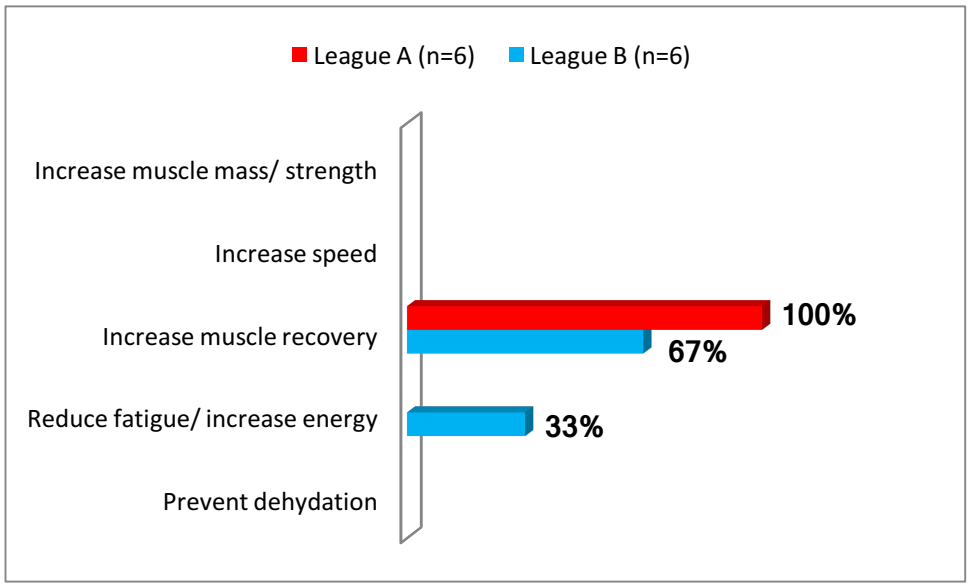
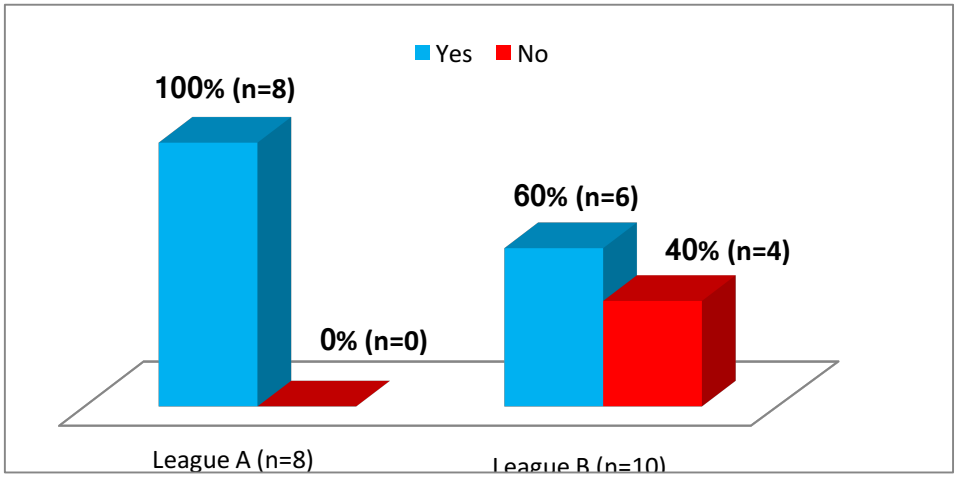


(N=12) Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.075)

Figure 3.12: Reasons coaches encourage glutamine supplements

3.5.3 Nutrition training

The main purpose of this section was to explore the coaches' supplement/nutrition training and their education regarding supplements. Figure 3.13 shows the number of coaches who received any form of training or education on supplementation. The Pearson (ML Chi-square) test was used to determine these statistics.



(N=18) (overall effect between League A and B is p<0.05)

Figure 3.13: Coaches who received training/education on nutrition and supplementation

Coaches were also asked where they received their nutritional training. In total, 78% of all the coaches received some kind of nutritional training. The majority [75% (n=6)] of League A

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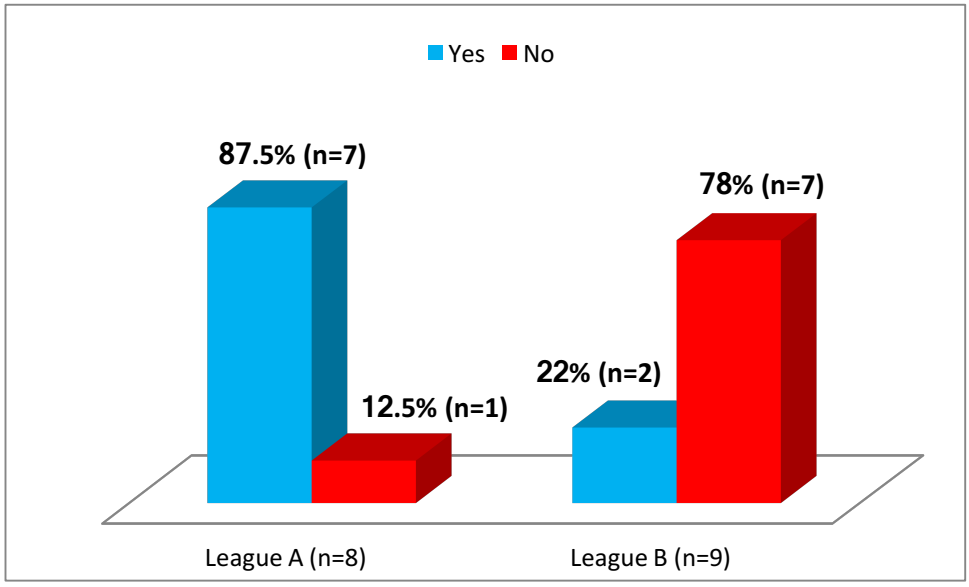
coaches received training at university or college level as part of a sport science degree. One other coach attended a two-day training course on brand-specific supplements from a pharmaceutical franchise while another coach received training from Western Province Rugby. In comparison, half of the League B coaches [50% (n=5)] received training at university or college level as part of a sport science degree. One other coach attended a one-day nutritional training course at the South African Rugby Union (SARU) while the rest of the coaches have not received any nutrition training.

Furthermore, the coaches were asked what their thoughts were on the ethicality of providing adolescent rugby players with supplements. It was found that the majority of the League A coaches considered it ethical to provide rugby players with supplements, whereas the League B coaches primarily disagreed. The Pearson (ML Chi-square) test was used to determine these statistics. This information is summarised in Figure 3.14.



(N=17) Test: Pearson (ML Chi-square) (overall effect between League A and B is $p<0.005$)

Figure 3.14: Coaches' view of the ethicality of providing adolescent rugby players with supplements

Lastly, the coaches were asked what sources primarily contributed to their knowledge of supplementation. The majority of the coaches reported that they obtained their supplement information from dietitians and pharmacists. This information is presented in Table 3.19.

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Table 3.19: Coaches' main sources of information on supplementation

Supplement advisor	Total (N=18)	League A (N=8)	League B (N=10)	p-level
Trainer	11% (n=2)	25% (n=2)	0% (n=0)	p=0.157
Supplement rep	22% (n=4)	0% (n=0)	40% (n=4)	**p<0.05**
Pharmacist	28% (n=5)	38% (n=3)	20% (n=2)	p=0.655
Dietitian	39% (n=7)	38% (n=3)	40% (n=4)	p=0.705

Test: Pearson (ML Chi-square) (overall effect between League A and B is $p<0.05$)

A significant number of the coaches reported that they obtained information on supplementation on the internet (see Table 3.20).

Table 3.20: Main media providing coaches with information on supplementation

Forms of media	Total (N=18)	League A (N=8)	League B (N=10)	p-level
Internet	72% (n=13)	88% (n=7)	60% (n=6)	p=0.782
Magazines	28% (n=5)	13% (n=1)	n=40 (n=4)	p=0.180

Test: Pearson (ML Chi-square) (overall effect between League A and B is p=0.182)

3.5.4 Knowledge

This section of the questionnaire evaluated the coaches' knowledge of various supplements. The knowledge scores of the respective knowledge questions of the coaches who answered correctly are summarised in Table 3.21.

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Table 3.21: Knowledge scores of coaches on supplementation

Knowledge component	Total (N=18)	League A (n=8)	League B (n=10)	p-level
Supplement labelling				
Supplements that are stated "safe" and "tested" can still harm health or reputation	78% (n=14)	89% (n=7)	70% (n=7)	p=0.364
Supplement labelling cannot always be trusted	83% (n=15)	88% (n=7)	80% (n=8)	p=0.668
Supplementing is not the only way to build muscles	89% (n=16)	88% (n=7)	90% (n=9)	p=0.867
Carbohydrate supplementation				
Carbohydrates optimise training and athletic performance	78% (n=14)	75% (n=6)	80% (n=8)	p=0.800
At least 50% of an athlete's total energy intake should consist of carbohydrates	56% (n=10)	38% (n=3)	70% (n=7)	p=0.165
Carbohydrates assist with recovery after exercise	89% (n=16)	88% (n=7)	90% (n=9)	p=0.867
Protein supplementation				
Natural protein-containing food is superior to protein in supplements	83% (n=15)	100% (n=8)	70% (n=7)	**p<0.05**
High amounts of protein intake can be harmful	78% (n=14)	88% (n=7)	70% (n=7)	p=0.364
Too much protein can lead to dehydration	50% (n=9)	38% (n=3)	60% (n=6)	p=0.341
Creatine supplementation				
Creatine is not proven safe for athletes younger than 18 years	78% (n=14)	63% (n=5)	90% (n=9)	p=0.159
Muscle mass is not gained through creatine intake	39% (n=7)	50% (n=4)	30% (n=3)	p=0.387
Creatine is also found in animal protein	83% (n=15)	88% (n=7)	80% (n=8)	p=0.668
Glutamine supplementation				
Glutamine supplementation is not proven to help prevention of muscle breakdown.	17% (n=3)	25% (n=2)	10% (n=1)	p=0.396
Glutamine does not help with recovery after training	6% (n=1)	0% (n=0)	10% (n=1)	p=0.269
Glutamine supplementation is not effective for athletes	6% (n=1)	0% (n=0)	10% (n=1)	p=0.269
Total knowledge percentage	60%	59%	60%	p=0.930

Test: Pearson (ML Chi-square)

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3.6 DETERMINING WHETHER SUPPLEMENT KNOWLEDGE IMPACTS THE USE OF SUPPLEMENTS

The sixth objective of this research was to determine whether there was a relationship between supplement knowledge and supplement use. The overall knowledge scores of all the questions were used to compare supplement users and non-supplement users. Hence, carbohydrate, protein, creatine and glutamine supplement users and non-supplement users' overall knowledge was compared to one another.

Table 3.22: Supplement knowledge of supplement-using players vs. non-using players

Supplements	**Supplement users**	**Non-supplement users**	**p-level**
Carbohydrates (N=189)	**(n=174)**	**(n=15)**	**p<0.05**
Knowledge mean	44% (±15%)	35% (±19%)	
Protein (N=189)	**(n=149)**	**(n=40)**	**p<0.005**
Knowledge mean	45% (±15%)	37% (±17%)	
Creatine (N=187)	**(n=70)**	**(n=117)**	p=0.080
Knowledge mean	46% (±16%)	42% (15%)	
Glutamine (N=187)	**(n=69)**	**(n=118)**	**p<0.005**
Knowledge mean	48% (±15%)	41% (±16%)	
All supplements (N=189)	**(n=180)**	**(n=9)**	**p<0.01**
Knowledge mean	44% (±15%)	30% (±21%)	

Test: ANOVA (analysis of variance)

3.7 SUMMARY OF FINDINGS

3.7.1 Demographic information

League A rugby players spent more time training (12±3.2 vs. 9±3.8 hours/week, $p<0.001$) and collectively have more years of playing rugby (11±1.4 vs. 10±2.9 years, $p<0.001$) than League B rugby players. Although League A and League B rugby players train with the same intensity, League A mainly focused on "ball and game plan" training (76% vs. 25%, $p<0.001$), whereas League B focused significantly more on "resistance" training (51% vs. 18%, $p<0.001$) and "sprinting" (19% vs. 3 %, $p<0.001$).

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3.7.2 The prevalence of supplement use

The majority of players used carbohydrates (92%) followed by protein (79%) while only 37% of players reported using creatine and glutamine. The prevalence of protein and glutamine use amongst League A players was significantly higher compared to League B players (90% vs. 69%, $p<0.001$ and 59% vs. 17%, $p<0.001$ for protein and glutamine respectively). Protein was the most frequently used supplement with 30% of players consuming protein on a daily basis. CHO were used up to three times per week by 39% of players.

3.7.3 Awareness of quantities consumed, supplement use by fellow teammates and future supplement use

The minority of players were aware of the amount of carbohydrates (4%), protein (22%), creatine (13%) and glutamine (4%) supplements they consumed on a daily or weekly basis with the exception of 29% of the League B players who were aware of the dose of protein they consumed. However, the majority of the rugby players were aware of fellow teammates using carbohydrate (97%), protein (97%), creatine (85%) and/or glutamine (76%) supplements. Furthermore, the majority of players reported that they will use carbohydrate (91%) and/or protein (90%) supplements in the future and more than half reported the future use of creatine (57%) and glutamine (59%).

3.7.4 Rugby players' knowledge of the usage, effectiveness and role of supplements

The overall knowledge scores on the usage, effectiveness and role of supplements were poor (43%) with League A players performing significantly better compared to League B players (48% vs. 39%, $p<0.001$). Knowledge regarding the role of glutamine supplementation in particular was very poor. Only a few of the rugby players were aware that muscle mass is not gained through creatine intake (13%) and that too much protein can lead to dehydration (23%). Yet, the majority of the rugby players knew that supplementation is not the only way to build muscle (92%). A higher number of League A rugby players were aware that supplement labelling cannot always be trusted (68% vs. 44%, $p<0.005$), that natural protein-containing food is superior to protein in supplements (63% vs. 33%, $p<0.001$) and that creatine can also be found in animal protein (87% vs. 55%, $p<0.001$).

3.7.5 Rugby players' resources, influences and reasons for supplement use

Overall, the majority of players obtained their supplements from pharmacies (34%) followed by supplement stores (32%). However, significantly more League B players obtained their

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supplements from pharmacies compared to League A players (43% vs. 23%, $p<0.01$), while the coaches (26% vs. 10%, $p<0.05$) and schools' authority figures (19% vs. 3%, $p<0,005$) supplied significantly more supplements to League A players compared to League B players. The main source of supplement information was the coach (28%), followed by the trainer (19%) and then the supplement representative (16%). A significantly higher number of League A rugby players reported receiving their information from the coach compared to League B players (43% vs. 15%, $p<0.001$). Significantly more League B rugby players received their supplement information from their parents compared to League A players (10% vs. 2%, $p<0.05$). The majority of players indicated that they needed education on supplementation and that they have not consulted a dietitian on diet and supplement use.

The pressure to use supplements was perceived to mostly come from friends and teammates (58%), rugby role models (56%) and the media (51%), with the internet reported as the most popular media source of information. League B rugby players experienced significantly more pressure from friends/teammates (67% vs. 49%, $p<0.05$), the media (61% vs. 41%, $p<0.05$) and rugby role models (67% vs. 45%, $p<0.05$) compared to League A players.

The main reported reason for using carbohydrate supplements was to reduce fatigue/increase energy (46%) followed by an increase in muscle mass/strength (29%). Protein is reportedly consumed to increase muscle mass/strength (72%) and secondly to enhance muscle recovery (24%). Creatine is used to predominantly increase muscle mass/strength while glutamine is reportedly used to enhance muscle recovery. A significantly higher number of League A players stated that protein increases muscle recovery (37% vs. 11%, $p<0.001$) compared to League B players.

3.7.6 The prior training, current knowledge and prescriptive behaviour of coaching staff towards their adolescent rugby players regarding supplementation

League B coaches had more years of coaching experience (17 (±11) vs. 8 (±6), $p<0.05$) than League A coaches. The coaches received an average knowledge score of 60%, although 78% of the coaches received some kind of nutritional training. The League A coaches' most popular reason for encouraging supplementation was to improve the team's overall performance, whereas League B coaches encouraged supplementation to increase muscle mass and strength. The majority of the coaches encouraged carbohydrate, protein and glutamine supplement use, while only 44% of the coaches encouraged creatine supplementation. The coaches also reported

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that their main source of supplement information was dietitians (39%), followed by pharmacists (28%) and supplement representatives (22%).

3.7.7 Determining whether knowledge of supplements impacts the use of supplements

Supplement users had a higher average of overall supplementation knowledge (44% vs. 30%, $p<0.01$) than non-supplement users. The carbohydrate (44% vs. 35%, $p<0.05$), protein (45% vs. 37%, $p<0.005$) and glutamine (48% vs. 41%, $p<0.005$) supplement users had significantly higher overall supplementation knowledge than the non-supplement users.

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3.7.8. Summary of the differences between League A and League B players

Table 3.23: Summary of League A and League B differences

In the table below, the league that has a significantly greater variable is highlited.

Variable	Total	League A	League B	p-level
Years of playing rugby (years)	11 (±2.4) (N=198)	11 (±1.4) (n=90)	10(±2.9) (n=99)	p<0.001
Training time (hours)	10(±3.7) (N=188)	12 (±3.2) (n=90)	9(±3.8) (n=98)	p<0.001
Type of training: (N=189)				
Resistance	35% (n=66)	18% (n=16)	51% (n=50)	p<0.001
Ball and game plan	49% (n=93)	76% (n=68)	25% (n=25)	p<0.001
Sprinting	12% (n=22)	3% (n=3)	19% (n=19)	p<0.001
Prevalence:				
Protein	79% (n=149/189)	90% (n=81/90)	69% (n=68/99)	p<0.001
Glutamine	37% (n=69/187)	59% (n=52/88)	17% (n=17/99)	p<0.001
Frequency of supplement use:				
Creatine use: 1-3 times per week	12% (n=22)	20% (n=17)	5% (n=5)	p<0.05
Creatine use: Daily	10% (n=19)	5% (n=4)	15% (n=15)	p<0.05
Glutamine use: 1-3 times per week	17% (n=32)	32% (n=28)	4% (n=4)	p<0.001
Future use:				
Glutamine	59% (n=104/177)	74% (n=63/85)	45% (n=41/92)	p<0.001
Aware of team usage:				
Glutamine	76% (n=141/186)	90% (n=81/90)	63% (n=60/96)	p<0.001
Knowledge scores:				
Total score (N=189)	43%	48%	39%	p<0.001
Supplement labelling cannot always be trusted	56% (n=105/189)	68% (n=61/90)	44% (n=44/99)	p<0.005
Natural protein-containing food is superior to protein in supplements	48% (n=90/189)	63% (n=57/90)	33% (n=33/99)	p<0.001

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Creatine is also found in animal protein	70% (n=132/189)	87% (n=78/90)	55% (n=54/99)	p<0.001
Supplement suppliers: Pharmacy	34% (n=63/188)	23% (n=21/90)	43% (n=42/98)	p<0.01
Coach	18% (n=33/188)	26% (n=23/90)	10% (n=10/98)	p<0.05
School	11% (n=20/188)	19% (n=17/90)	3% (n=3/98)	p<0.005
Pressure to use supplements: Friends:				
Agree	46% (n=87/188)	39% (n=35/89)	53% (n=52/99)	p<0.05
Strongly agree	12% (n=23/188)	10% (n=9/89)	14% (n=14/99)	
Media:				
Agreed	34% (n=63/185)	24% (n=21)	43% (n=42/97)	p<0.05
Strongly agree	17% (n=32/185)	17% (n=15)	18% (n=17/97)	
Rugby role models:				
Agree	38% (n=70/183)	29% (n=25/87)	47% (n=45/96)	p<0.05
Strongly agree	18% (n=33/183)	16% (n=14/87)	20% (n=19/96)	
Supplement advisor: Coach	28% (n=52/185)	43% (n=38/89)	15% (n=14/96)	p<0.001
Parents	6% (n=12/185)	2% (n=2/89)	10% (n=10/96)	p<0.05
Reason for supplement use: Protein: Increase muscle recovery	24% (n=43/181)	37% (n=33/89)	11% (n=10/92)	P<0.001
Coaches: Years of coaching	13 (±10) (N=18)	8 (±6) (n=8)	17 (±11) (n=10)	p<0.05
Nutritional training	78% (n=14/18)	100% (n=8/8)	60% (n=6/10)	p<0.05)
Ethical to provide supplements	53% (n=9/17)	87.5% (n=7/8)	22% (n=2/9)	p<0.005
Source of information	22% (n=4/18)	0% (n=0/8)	40% (n=4/10)	p<0.05
Knowledge: Natural protein-containing food is superior to protein in supplements	83% (n=15/18)	100% (n=8/8)	70% (n=7/10)	p<0.05

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3.7 NULL HYPOTHESIS

a. The knowledge of adolescent male rugby players from premier league schools regarding supplementation does not influence their supplement usage (as proven in section 3.6).
   - **Null-Hypothesis is rejected**

b. There is no difference between premier A and B league rugby schools' supplement use and motivations (influences and reasons) for supplement use in the Western Cape (as seen in League A and League B differences summary in Table 3.23).
   - **Null-Hypothesis is rejected**

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CHAPTER 4: DISCUSSION

4.1 INTRODUCTION

The main aim of this study was to determine the prevalence, knowledge and reasons for the use of carbohydrate, protein, creatine and glutamine supplements among adolescent male rugby players from League A and League B schools in the Western Cape, South Africa. The discussion of the results will be presented in line with the objectives of the study, integrating the results from the comparison of League A and League B schools where relevant.

4.2 PREVALENCE OF CARBOHYDRATE, PROTEIN, CREATINE AND GLUTAMINE USE

Based on the findings of this study, carbohydrate supplements (92%) were the supplements most used by all of the rugby players. In addition, a study conducted by Gradidge et al.[40] in Johannesburg, South Africa, reported carbohydrate supplement use (54%) to be one of the most prevalent among 100 athletes who took part in competitive high school sport. The different results could be ascribed to the fact that the present study may have included a broader variety of what is known as carbohydrate supplements. Sports drinks and energy bars were included as examples of carbohydrate supplements in the questionnaire used in the present study. The Gradidge et al.[40] study did not specifically state what they include as a carbohydrate supplement. Participants could have excluded examples like Energade and energy bars as it is not necessarily seen as a typical dietary supplement.

Carbohydrate supplementation plays a role in meeting adolescent athletes' nutritional requirements, but only to add onto a complete diet in cases where needed. Even in these cases it should be approached with caution as only reliable and safe sources of these supplements should be encouraged.[17, 19]

The rugby players in the present study seemed to know the benefits of some of the supplements investigated in the study that could have influenced their prevalence of supplement use. About half of the rugby players indicated correctly that carbohydrate supplements reduced fatigue/increase energy (46%), while 29% reported that CHO increased muscle mass/strength. The majority of the rugby players also answered correctly that protein supplements increased muscle mass and strength (72%) and that it enhanced muscle recovery (24%). The correct use

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of carbohydrate and protein supplements combined with a healthy diet could amplify the benefits of these supplements. Similarly, according to the Duelman et al.[24] study done among 61 high school football players 72% of the participants knew how to use protein supplements to gain muscle.[13, 14] Therefore, it can be concluded that the majority of the rugby players in the present study use carbohydrate and protein supplements for nutritionally acceptable reasons.

Furthermore, protein (79%) was the second most prevalent supplement among the adolescent rugby players. The Gradidge et al.[40] study reported protein supplement use (61%) to be the most prevalent among 100 athletes who took part in competitive high school sport. In contrast with these findings, a study conducted by Walsh et al.[41] in Ireland among 203 senior schoolboy rugby players reported a low prevalence of 44% of protein supplementation. Similarly, a study undertaken by Duvenhage et al.[21] in South Africa among 198 under-16 national-level rugby players reported a prevalence of 31% protein supplement usage. Additionally, 37% of the rugby players in the present study admitted to using glutamine supplements. In contrast with the findings in this study, Duvenhage et al.[21] found that less than 5% of the rugby players stated that they use glutamine supplementation. The low percentages of protein and glutamine supplementation could be ascribed to the taboo associated with doping and the fear that admitting to the use of certain supplements could threaten the players' rugby careers. Even though anonymity was assured, the elite group of selected rugby players participating in the Duvenhage et al.[21] study were not prepared to risk their careers by taking certain supplements. In addition, positive doping tests can ruin such players' reputation and rugby careers.[17] Consequently, the figures reported could be as a result of the stigma associated with using protein supplements and fear of endangering their careers.

The prevalence of protein and glutamine use among League A players was significantly higher compared to League B players (90% vs. 69%, $p<0.001$ and 59% vs. 17%, $p<0.001$ for protein and glutamine respectively). One possible explanation is that League A schools tend to have more public exposure, providing opportunities for supplement manufacturers to promote their brands and supplements by sponsoring high-profile teams. This is reflected in the present study as significantly more League A players obtained their supplements from coaches (26% vs. 10%, $p<0.05$) and the school (19% vs. 3%, $p<0,005$), while League B players obtained their supplements mostly from pharmacies (43% vs. 23%, $p<0.01$).

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Additionally, the majority of the League A coaches believed it is ethical to provide adolescent athletes with supplements, whereas the minority of the League B coaches believed this (87.5% vs. 22%, $p<0.005$). This could be another explanation for the increased protein and glutamine supplement use in League A in comparison with League B rugby players. Interestingly, the knowledge scores of both League A and B coaches were average.

Overall, the majority of players obtained their supplements from pharmacies (34%) followed by supplement stores (32%). Similarly, in a study done by Strachen[42] among 68 rugby players in secondary schools from KwaZulu-Natal, the majority of the rugby players reported that they obtained their supplementation from pharmacies (70%), followed by supermarkets (11%).

The daily consumption of protein is important for optimal growth, and adolescent athletes have slightly increased protein needs in comparison to their non-athletic counterparts. However, these requirements can easily be met through a healthy, balanced and varied diet. Additionally, the quality of the protein provided by supplementation is not superior to that found in food. Protein supplementation may be recommended in cases where athletes follow a poor diet, need to cope with stressful academic and athletic demands, or follow vegan or vegetarian diets.
A total of 37% of the rugby players in the present study admitted to using creatine supplements. This is in accordance with the Gradidge et al.[40] and Walsh et al.[41] studies showing a prevalence for creatine use of 29% to 32% among rugby players. This is concerning as according to the American College of Sports Medicine, creatine supplements should not be used by anyone younger than 18 years as a result of potential adverse effects.

Although adult athletes are increasingly taking creatine, the use of creatine by athletes younger than 18 years may not be safe until proven otherwise. Hence, it should be kept in mind that the potential dangers of creatine supplementation such as gastro-intestinal distress, muscle stiffness and loss of appetite may overshadow any possible benefits including improved sprinting performance.[25, 27]

Additionally, the rugby players in the present study seemed to have a different understanding as to the reasons for creatine and glutamine supplementation. The majority of the rugby players stated that creatine supplements increased muscle mass and strength, whereas it is actually a source of fuel that provides instant energy and that assists to increase speed. Only 1% of the rugby players in this study stated that creatine supplementation increases speed. Therefore, it

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is clear that these rugby players do not understand the reasons for using creatine.[2] Also, the majority of the rugby players in the study stated that glutamine supplementation increases muscle recovery. There is no evidence to support glutamine supplement benefits in sport as glutamine is a non-essential amino acid.[29] Hence, this is merely another example of how marketing misrepresents science and how misconceptions could possible increase the prevalence of supplement use.[6]

The participants in the present study were asked to indicate how frequently they used specific supplements. The results suggested that protein was the only supplement that most of the rugby players used on a daily basis. Carbohydrate, creatine and glutamine supplements were mostly used one to three times per week. Strachen[42] reported that frequency of supplement use ranged from two to three times per week to more than once a day. In addition to prevalence and frequency of use, the quantity of supplement use in the present study is also important. However, only a small number of players in the present study were aware of the amount of carbohydrates, protein, creatine and glutamine supplements they consumed on a daily or weekly basis, with the exception of 29% of the League B players who were aware of the dose of protein they were consuming. These findings show that the adolescent rugby players in the present study are not fully aware of the amount of supplements they consume. Another explanation could be that the participants follow the instructions on the supplement container and do not remember how many scoops or grams they consume. This is concerning, seeing that incorrect and increased amounts of supplement intake could lead to potential adverse health effects, including renal failure, weight gain and various other supplement abuse related health conditions.[17]

The majority of the rugby players in this study indicated that they would use carbohydrate (91%) and/or protein (90%) supplements in the future, whilst more than half also stated that they would use creatine (57%) and glutamine (59%) supplements in the future. Moreover, the majority of the rugby players in the Gradidge et al.[40] study were of the opinion that the use of performance-enhancing substances are increasing. The Hildebrandt et al.[15] and the Buckman et al.[16] studies showed that athletes who used nutritional supplements could be at a particularly high risk to participate in other problematic substance-abuse behaviours later in life, such as alcohol abuse and steroid use. Thus, it can be deduced that education and preventative efforts may benefit the health and behaviour of adolescent athletes by targeting rugby players on high school level.[1, 8, 17]

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4.3 THE RUGBY PLAYERS' KNOWLEDGE OF THE USAGE, EFFECTIVENESS AND ROLE OF SUPPLEMENTS

The second objective was to determine the rugby players' knowledge of supplement usage and the effectiveness of supplements. The knowledge questionnaire was divided into five different sections, namely supplement labelling, and carbohydrate, protein, creatine and glutamine supplementation.

The overall knowledge scores were poor (43%), with League A players performing significantly better compared to League B players (48% vs. 39%, $p<0.001$). This could be due to the increased exposure of League A rugby players to relevant information resources such as rugby workshops, supplement represtatives and nutrition related education. However, only a small percentage of League A (12%) and League B players (14%) has ever consulted a dietitian regarding their diet or supplement use.

Additionally, the supplement knowledge score of the coaches in this study was an average of 60% for League A and League B coaches. This could also be a reason why League A rugby players had a higher knowledge score, as coaches were their main source of information. Whereas, parents were League B rugby players' main source of information and would probably have a lower supplementation knowledge score in comparison to coaches.

The Walsh et al.[41] study undertaken among senior schoolboy rugby players in Ireland received an average score of 60%. The higher score could be the result of different education and nutritional training programmes in Ireland versus South Africa. The Walsh et al.[41] study was also limited to rugby players competing at the Senior Schools Cup Level and the questionnaire also focused on nutritional knowledge and not merely supplement-use knowledge, as with the present study.[3]

Less than half of the rugby players in the present study knew that supplements that stated "safe" and "tested" can still harm their health and reputation. These findings concur with the Duvenhage et al.[21] findings where only 40% of the rugby players knew that taking supplements was not always safe. These findings show that adolescent athletes' awareness of the potential risk associated with performance-enhancing supplements is very low.

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Some of these misconceptions include the belief that supplement manufacturers declare all the ingredients and nutritional information on the nutritional information label. Approximately half of the participants in this study knew that the information on supplement labels cannot always be trusted. A similar low percentage of athletes (40%) in the Duvenhage et al.[21] study knew that taking a supplement could lead to a positive doping test. Hence, this vulnerable age group could fall victim to the advertising of unscrupulous supplement manufacturers to increase supplement use among these adolescent athletes.[4, 46]

Interestingly, 84% of the athletes in the Walsh et al.[41] study knew that claims made on dietary supplement labels should not always be trusted. Regardless, 67% of the participants who knew this were taking supplements. The reason for this could be that the athletes do not understand the true risks associated with the ingestion of excessive amounts or prohibited ingredients in supplements. These results emphasise the need for scientific, evidence-based safe and effective supplement education, starting in high school. This will ensure that adolescent athletes have a better understanding of the use of supplements when they graduate from high schools and go on to represent varsity or provincial teams. [2, 3]

It could also be that better rugby players and better teams are more exposed to supplement education and workshops. This is reinforced by the findings that more than half of League A rugby players answered this question correctly while less than half of League B rugby players knew that supplement labels cannot always be trusted (68% vs. 44%, $p<0.005$).

Similarly, the reason for the difference in these results is mirrored by the difference reported between League A and League B (63% vs. 33%, $p<0.001$) participants' knowledge that protein in supplements is not superior to natural protein contained in food. The belief among adolescent rugby players that protein from supplementation is superior to the protein from food is a cause for concern, as this shows that these rugby players value supplements more than the nutrients obtained from food. Additionally, a significant difference was found between the two leagues' knowledge regarding the fact that creatine is also found in animal protein. The majority of League A rugby players knew this fact, whereas only half of League B rugby players were aware of this (87% vs. 55%, $p<0.001$).

The participants in the present study were asked if using supplements was the only way to build muscle. Most of the rugby players in this study knew that supplementation is not the only way

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to build muscle. This is in contrast with the Duvenhage et al.[21] study in which only 32% believed that they do not have to take supplements to increase muscle. The difference between these results could be ascribed to the fact that the participants in the Duvenhage et al.[21] study were top South African rugby players selected by a national selection panel to attend a special training and educational camp. Among these rugby players the pressure to outshine other players is intense and the reliance on supplementation to improve overall performance could be immense. Additionally, using supplements is not the only way to build muscle mass as correct training, optimal meal plans, sufficient rest and recovery are important for the optimal growth, development and lean muscle growth of young athletes.[4, 46]

All the rugby players in the present study showed poor knowledge regarding the amount of carbohydrates in the diet of a rugby player. For example, less than half of the rugby players knew that at least 50% of an athlete's total energy intake should consist of carbohydrates. A review by Casiero[23] focusing on optimal nutrition for rugby players stated the importance of consuming a diet high in carbohydrates to improve overall performance and to delay fatigue.

In contrast, the majority of rugby players in the Walsh et al.[41] study knew that most of their energy should come from carbohydrates. One of the reasons why the South African adolescent rugby players avoid high carbohydrate intake could be ascribed to the recent low-carbohydrate diet trend. Low-carbohydrate fad diets add to the ignorance surrounding the importance of wholesome and sufficient carbohydrates in an athlete's diet. [2, 3, 9, 10, 11]

Accoring to the Bell et al.[14] study, adolescents tend to focus more on the performance-enhancing benefits of protein supplements than any other supplements. Substituting carbohydrates with other supplements like protein could deprive the adolescent athlete from critical energy needed for optimal growth and development. [2, 11, 13] These results give the impression that the rugby players do not understand the true nutritional and ergogenic benefits of carbohydrates or how to incorporate carbohydrates as part of a healthy diet.

The next section of the knowledge questionnaire evaluated the rugby players' knowledge of protein supplement use. Less than half of the participants knew that the protein in supplements is not superior to natural protein contained in food. This is supported by the results in the present study where the majority of the participants stated that they have never consulted a dietitian. This is in contrast with the Duvenhage et al.[21] study where 60% of the under-16 rugby

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players knew that the protein in supplements is not superior to natural protein contained in food. The reason for the difference in the findings could be because the under-16 rugby players were national-level rugby players and was selected by a national selection panel. This highly talented group of athletes possibly have a better knowedge regarding protein supplementation, especially as protein supplements (31%) were reported as the most prevalent supplement used among this group.

In this study, more than half of the rugby players knew that a high amount of protein intake can be harmful. However, only 23% of the rugby players knew that too much protein can lead to dehydration. Adolescent athletes are more susceptible to dehydration as a result of their increased body surface to weight ratio. This shows that the rugby players know that there are side effects to using excessive supplementation, but their knowledge regarding the details of the harmful effects are lacking. In another study undertaken by Duelman[24] among 61 high school football players from a small Midwestern town in Illinois, 45% of the football players believed there is no risk associated with taking protein supplements.[14]

More than half of the rugby players in the present study stated that they know that creatine is not proven safe for athletes younger than 18 years. Similarly, Duvenhage et al.[21] reported that 46% of participants knew that they should not take creatine supplementation. It is known among high school rugby players that long-term health studies have not been performed on adolescent athletes. Hence, this information should form part of education sessions to increase awareness of supplementation among adolescent athletes. Consequently, the younger group of respondents are still unaware of the potential dangers and the recommendations associated with the use of creatine as supplement. Concerns do exist regarding the impact of regular and irresponsible creatine use on the kidneys of healthy athletes, although the long-term effects of this are still unknown. Consequently, creatine use is not recommended for athletes younger than 18 years. Athletes older than 18 years should use it cautiously and under practitioner supervision untill long-term and large-population studies have been conducted. [2, 4, 46] All supplement users, and in particular high school athletes, should be made aware of the risks associated with the intake of supplements.

The respondents in this study knew the least about glutamine supplementation. As stated in the Eichner[29] review, and according to internet sources, glutamine claims to be "essential for serious athletes" to "increase growth hormone" and to "enhance muscle metabolism". Claims

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are being made that glutamine is vital for optimal immune functioning and that one cannot get enough glutamine from food or produce enough glutamine when training. However, the research does not support the claims made on the glutamine product labels or in the media. The participants in the present study were not aware that glutamine supplementation has not been proven to help prevent muscle breakdown and to help with recovery after training. Current data shows that glutamine supplementation is only beneficial for athletes with real glutamine deficiency, which is rare.[29, 30]

In addition to the rugby players' overall poor supplement knowledge, the vast majority of the rugby players in the present study stated that they need more education on supplementation. Similarly, the majority of the rugby players in the Walsh et al.[41] study perceived that they could benefit from nutritional education. This shows that the rugby players do have a desire to know more about optimal sport nutrition. However, the supplement advisors like their coaches, friends and family members available to them do not have sufficient knowledge of this topic.[3] Most of the rugby players in this study stated that they have not consulted a dietitian on their diet or supplement use. This opens up an opportunity for dietitians to approach schools to educate sport teams on the effective and safe use of supplements. Schools can include dietitians in their coaching teams. This recommendation is supported in the Gradidge et al.[40] study where the majority of the participants also stated that they believe sport organisations should offer educational programmes for athletes regarding the use of supplements in sport. Dietitians could lead these educational programmes to provide rugby players and coaches with up-to-date information on the benefits, reasons and proper way to incorporate supplementation, and on the importance of proper nutrition through following a complete nutritional meal plan, before supplementing.[1, 2]

4.4 THE RUGBY PLAYERS' MOTIVATION AND INFLUENCES FOR THE USE OF SUPPLEMENTS

The third objective was to investigate the motivation and influences for the rugby players to use supplementation. The pressure they experience to perform well was also investigated as this could increase supplement use among high school rugby players.

The rugby players in the present study were asked to assess the pressure they experienced from different people and influencers in their lives to use supplements in order to perform on the rugby field. Overall, the pressure to use supplements was perceived to mostly come from

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friends and teammates (58%), rugby role models (56%) and the media (51%), with the internet reported as the most popular media source of information.

The internet is the primary media channel used by 67% of the rugby players in the present study to research information on supplementation. The reason for this may be the easy access to the internet via computer rooms in schools and cell phone access. Similarly, the Gradidge et al.[40] study estimated that 72% of the adolescent participants stated that they use the internet to research performance-enhancing substances. The internet could be a good source of information, but most of the information is not reviewed or controlled by authorities or governing bodies. Additionally, the claims made by supplement companies on their websites are not supported by peer-reviewed or science-based research articles. Furthermore, the research to support claims made by sport-related supplements is often lacking or too academic and hence inaccessible to young athletes. It can be concluded that there is a need for sufficient quality evidence to inform the public, including athletes, of the advantages and disadvantages of the various supplements available.[1]

Additionally, League B rugby players experienced significantly more pressure from friends or teammates (67% vs. 49%, $p<0.05$), the media (61% vs. 41%, $p<0.05$) as well as rugby role models (67% vs. 45%, $p<0.05$) compared to League A rugby players. A possible explanation could be that League B schools usually have less funds and sponsorships to give to athletes compared to League A schools. Therefore, League B rugby players could experience pressure from friends and teammates as some players in the team have the finances to buy their own supplements and others do not have the financial support from their families. The Duvenhage et al.[21] study evaluated rugby players' attitudes and beliefs regarding nutrition and supplementation, and stated that 42% of the participants felt pressured by their coach and/or parents to increase their lean body mass.[4, 46]

The majority of the rugby players in the present study were aware of fellow teammates using carbohydrate (97%), protein (97%), creatine (85%) and/or glutamine (76%) supplements. This awareness could have an influence on rugby players who do not already use supplements. Consequently, subliminal pressure (i.e. peer pressure) may play a role in getting non-supplement users to use supplements in a team where it has become the norm to use supplements. This links to the point of false reporting when the use of supplements may be frowned upon by authority figures and regulatory bodies. Adolescent rugby players are at a

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vulnerable age and are easily influenced by peer pressure and external factors like the media and rugby role models who could promote improper supplement practices. In the Gradidge et al.[40] study, 84% of the high school males who participated in competitive sport believed that there is increased pressure on high school athletes to use substances in sport.[1, 2]

Adolescent rugby players' sources of information and suppliers of supplements could have a significant impact on their use, attitude and knowledge regarding supplementation. The main source of supplement information identified in this study is the coach (28%), followed by the trainer (19%) and then the supplement representative (16%). Supplement companies that sponsor school rugby teams can also put pressure on adolescent rugby players to use supplements without disclosing the risks associated with the incorrect use of such supplements. The minority of the rugby players participating in this study would ask for advice from doctors or dietitians whom are health professionals that will have more knowledge and expertise compared to coaches, trainers and supplement representatives to prescribe sports supplements.

Furthermore, League A and League B rugby players approach different individuals for information on supplements. A significantly higher number of League A rugby players asked their coaches for information compared to League B players (43% vs. 15%, $p<0.001$). Significantly more League B rugby players asked their parents about supplements when compared to League A players (10% vs. 2%, $p<0.05$). It is unlikely that these "preferred" supplement advisors will have sufficient knowledge to provide the young rugby players with scientific information. Most of the participants from the League A schools lived in school residences. The absence of their parents could also be why most of them went to their coaches for advice on sport supplements. This highlights the need to create a safe space for young rugby players in which they can access reliable information on sports nutrition. One possible solution is to assign a dietitian to each school or district to advise athletes on nutrition and supplements. Reliable information on supplements should be easily accessible for rugby players to make informed decisions as these rugby players are ultimately responsible for their own health. Hence, the rugby players should have access to knowledgeable people and consultants whose advice they can follow.[2]

In similar studies, coaches, personal trainers and friends were listed as their main sources of information. In the Walsh et al.[41] study done among rugby players in Ireland 67% look to

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coaches for advice, 36% look to their teammates and friends and only 8% of the participants cited healthcare professionals. [1, 3, 13]

4.5 SUPPLEMENT USE DETERMINED BY SUPPLEMENT KNOWLEDGE

The overall knowledge score of the rugby players in the present study was used to compare supplement users with non-supplement users. Carbohydrate, protein and glutamine supplement users had more supplement knowledge than non-supplement users. Overall supplement users also had more supplement knowledge than non-supplement users. However, this does not mean that supplement users are using the supplements correctly.

Additional education is required to assist with the practical and correct inclusion of supplements in a daily meal plan. The Walsh et al.[41] study done in Ireland among senior schoolboy rugby players examined the disparity between their knowledge and their nutritional practices. Many of the participants knew which healthy eating practices they should follow, but not many implemented these practices. Most of the athletes had a positive attitude towards nutrition, although poor knowledge and dietary application had been observed.[3]

The findings of the present study are supported by the Nieper[38] study undertaken among junior national track and field athletes in the United Kingdom (UK). In the UK study, athletes who supplemented their diet reported increased knowledge levels compared to those who did not use supplements. The increased knowledge of the athletes who incorporated supplements in their diet could be influenced by their possible over-confidence in their own decision-making abilities. All the studies consulted for the purposes of this research and the present study itself yielded results that indicated that respondents did feel the need to receive or seek further nutritional training and education.[13]

Incorporating education programmes will be the most effective way to educate coaches and rugby players on how to follow an effective meal plan and safe supplement use, where needed. Sports people look up to their coaches and ask their advice on, among others, supplementation. The problem arises when coaches have an insufficient understanding of sport supplements. Hence, qualified nutrition professionals now play a key role in the success of sports teams. Unfortunately, limited funding (on the side of the sports teams) and the inability to recognise the value of qualified nutrition professionals can lead to limited uptake of such services.[2, 23]

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4.6 PRIOR TRAINING, CURRENT KNOWLEDGE AND PRESCRIPTIVE BEHAVIOUR OF COACHING STAFF

The fourth objective of the study was to investigate the coaches' prior training, knowledge and prescriptive behaviour towards their adolescent rugby players. In this study, the coaches had an average of 13 years of experience. League A coaches had significantly less coaching experience, with an average of eight years. League B coaches had an average of 17 years of experience. A study conducte by Zinn et al.[36] among 168 New Zealand (Senior A grade) club coaches found that the majority of the coaches had two to five years of coaching experience. This shows that increased experience is not necessarily associated with better team performance or better nutritional practices.

One of the questions assessed the coaches' prior training in terms of nutrition. The majority of the coaches participating in the present study received their training at university or college. The majority of the coaches in this study also received some kind of nutritional training that was either part of their coach training or a separate short course, workshop or supplement-related information session.[23]

A study undertaken by Couture et al.[37] among 47 coaches from five high schools in the greater region of Quebec (among male and female coaches who coached a variety of sports) reported that the majority completed their National Coaching Certification Program. In the Zinn et al.[36] study, 61% of the coaches have not attended nutritional training.

To the best of the researcher's knowledge, nutritional training for sports coaches in South Africa is not compulsory. This is also suggested by the results of this study. This lack of nutritional knowledge should not be acceptable as athletes, such as rugby players, look at their coaches for fitness and nutritional advice. [17]

League A and League B coaches had an average knowledge score of 60% which showed that there was no correlation between the coaches' number of years of coaching experience and their knowledge of nutrition. In the Couture et al.[37] study, more than half of the coaches considered themselves to be knowledgeable in the area of sport nutrition. The coaches in the Couture et al.[37] study had an average knowledge score of 68%. Also, Couture[37] found that the coaches with a university education achieved significantly better knowledge scores than

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coaches with a lower education. This finding supports the recommendation for further nutritional education.[23]

The coaches in the Zinn et al.[36] study responded correctly to 53% of all the knowledge questions. However, they fared the worst in the supplement category of the questionnaire, scoring only 33%. These results suggest that rugby coaches are inadequately prepared to impart nutritional advice to athletes and could benefit from further nutritional education. [17] The Zinn et al.[26] study also showed that coaches who imparted nutritional advice obtained a significantly higher knowledge score of 57% compared to those who did not impart nutritional advice and who only obtained a knowledge score of 48%.

In this study, the knowledge section of the questionnaire covered mostly supplement knowledge. Here, the coaches received an average of 60%, whereas the coaches in the Zinn et al.[36] study received an average of 33% in the supplement knowledge section in their nutritional questionnaire. This shows that the coaches in the present study are more knowledgable of supplementation in comparison to the coaches in the Zinn et al.[36] study. However, it is still recommended that sport coaches in South Africa complete compulsory nutrition training as their current minimal or optional training does not equip them with sufficient knowledge of sport nutrition.

The participants in the Smith Rockwell et al.[47] study done among 53 male and female coaches from the 21 Division I intercollegiate sports, along with the strength and conditioning and coaching staff at Virginia Polytechnic Institute and State University, scored an average of 67% on their nutrition knowledge questionnaire. It is important to bear in mind that this questionnaire was not limited to questions on supplements; it also included topics like nutrition, vitamins, minerals and weight control. Thus, the Smith Rockwell et al.[47] study also reinforced the need for further nutritional education.

It is therefore recommended that coaches are equipped to access nutritional information from reputable sources in order to share this knowledge with the athletes they train, where required.[24] Coaches should encourage and support the health and safety of adolescent athletes, and help to ensure that they follow research-based recommendations. In the present study, the majority of the coaches recommended the use of carbohydrate, protein and glutamine supplementation while about half of the coaches recommended creatine supplementation. According to the

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Couture et al.[37] study, one of the practices that coaches most prevalently recommend to athletes is to increase their protein percentage intake at the expense of carbohydrates. The majority of the coaches in the Zinn et al.[36] study provided nutritional advice to their rugby players while having very poor knowledge of nutrition themselves. [17, 23, 41]

In this study, the coaches were asked why they encouraged supplement usage. The majority of the League A coaches said the reason was to improve their team's overall performance and to turn them into better rugby players. By contrast, the majority of League B coaches encouraged supplement use to increase their athletes' muscle mass and strength. Only a few of the coaches stated that they wanted to improve their rugby players' health. This shows that the health of the athletes was not necessarily a priority for the coaches.

Additionally, more League A coaches personally make use of creatine (29% vs. 0%, $p<0.05$) and glutamine supplementation (50% vs. 0%, $p<0.005$) in comparison to League B coaches. This could also influence their perception regarding their recommendation of supplementation to their rugby players. Incorrect supplement recommendations by coaches can damage the health and reputation of rugby players. Incorrect recommendations can also influence the rugby players knowledge of supplement use and consequently their supplement use behaviour. However, coaches have an ethical obligation to ensure that the health and reputation of their athletes are not sacrificed in the pursuit of victory.

Most of the coaches participating in the present study indicated that they get their nutritional information from the internet, dietitians and/or pharmacists. However, the researcher/fieldworker is a qualified dietitians. The study participants were aware of this, which may have influenced the final results. Coaches should be aware that in most cases, dietitians are the most knowledgeable in the field of nutrition. Supporting this notion, the majority of the coaches in the Zinn et al.[36] study stated that they get their information from lecturers, seminars or courses, followed by the internet and magazines. Other sources of information included physiotherapists, personal trainers, trainers and doctors. However, the Zinn et al.[36] study also found that only 7% of the coaches obtained supplementation information from dietitians. A total of 18% of the coaches in this study did not seek nutritional advice at all.[36]

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The Couture et al.[37] study showed that the majority of the coaches obtained their information from the internet and friends. Physicians and scientific papers were the least used sources of information, while 30% of the coaches obtained their supplementation information from dietitians.

Taking into account the Zinn et al.[36] and Couture et al.[37] studies, it can be inferred that the present study was impacted by the coaches' awareness of the researcher/ fieldworker's profession, namely a dietitian. [17, 23]

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CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSIONS

The majority of rugby players surveyed in this study used CHO, followed by protein supplements, with fewer using creatine and glutamine. It was evident from the results that knowledge regarding safe and appropriate supplement use is currently lacking in both League A and League B rugby schools in the Western Cape. The main reasons why these rugby players use supplements are to increase energy/reduce fatigue, increase muscle mass and assist with muscle recovery. Carbohydrates will help to increase energy/reduce fatigue and, similar to protein, will also increase muscle mass and assist with recovery. There is a misconception regarding the reasons for creatine and glutamine use. Additionally, only a few of the athletes were aware of the amount of supplements they consumed on a daily or weekly basis. Athletes look to coaches and trainers for nutritional information, unaware that these coaches and trainers also lack knowledge about supplements.

The majority of the participants showed interest in more education on this topic. High school athletes are under significant pressure to perform on the field, leading to the use of supplements to cope.

Considering the health consequences of irresponsible and incorrect supplementation, it may be unwise to sacrifice long-term health benefits for insignificant muscle and performance gains in the short term. Top performances on the sports field could lead to rewards, bursaries and honorary status among peers and teachers. Unfortunately, the supplement industry is a mostly unregulated market. Additionally, minimal data exists to support safe supplement use among adolescents or to confirm the claimed benefits stated on supplements. Consequently, early supplement use could be a gateway to illegal substance use and alcohol abuse – as well as the associated health risks – later in life.

The key message is that up-to-date nutritional education for coaches and adolescent rugby players could improve the performance and health practices of the teams. It is clear from the research that the rugby players desire further education on nutritional supplements. This opens up an opportunity for dietitians to educate coaches and athletes via group and individual

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consultations. This will enable athletes and coaches to make informed choices for the benefit of their teams and sustained success.

5.2 RECOMMENDATIONS

The use of nutritional supplements can lead to positive doping tests as a result of the inadvertent use and/or deliberate contamination of sport supplements. As a result, it is crucial for healthcare professionals and authority figures working with young athletes to be aware of the increased supplement use among this group, especially carbohydrate and protein supplementation. Healthcare professionals and authority figures should intentionally ask adolescent athletes about supplement use and be aware of new supplements on the market. Adolescent athletes are particularly at risk as they are under pressure to perform well. They are also increasingly exposed to the supplement manufacturers' emotive advertising that encourages young athletes to use supplements.

The following initiatives and guidelines are therefore recommended:

- **Regulation and education**: Regulatory changes and education initiatives can help to address the challenge of incorrect and unsafe supplement use among high school and other athletes.
- **Supplement training for coaches**: South Africa should implement a high school sport supplement policy requiring all coaches to complete a standardised training programme on sports nutrition and supplementation. All coaches should therefore be trained in safe and effective supplement use, as high school athletes continue to look to their coaches for nutritional and supplemental guidance.
- **Educational programmes for athletes, parents and authority figures**: Education programmes for high school athletes, parents as well as authority figures on optimal nutrition and safe supplementation will empower everyone involved in sports training to make informed choices regarding supplementation. Educational interventions are also important to address the ethical and the health consequences of supplement use, and to address the challenge of doping in sport. It is recommended that these educational interventions are offered to athletes from an early age to decrease doping incidences, implement anti-doping behaviour and encourage socially acceptable sporting behaviour.

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- **Dietitian services**: Consulting dietitians can play a key role in overseeing the provision and use of supplements. Schools should only allow high school athletes to use supplements once they have consulted a dietitian. Dietitians can provide coaches and high school athletes with research-based information on nutritional supplements, optimal meal plans for athletes, when to take the supplements, how to select safe supplements and how to ensure clean doping tests. Coaches and rugby clubs should encourage young athletes to use dietitian services.

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CHAPTER 6: LIMITATIONS OF THIS STUDY

This study aimed to determine the prevalence and knowledge of and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Province.

6.1 LIMITATIONS OF THE STUDY

The study was limited to first team rugby players from 10 high schools in the Western Cape, which makes it difficult to generalise the study's findings and to apply them to all high school rugby players. Additionally, the researcher/fieldworker was a qualified dietitians and could have influenced how the participants' answered some of the questions. The questionnaire used in this study was evaluated by 2 external dietitians and gone though a thorough pilot study, however not all the validity and reliability tools were not used on this questionnaire.

Another limitation was investigating the use of only four sports-related supplements. Hence, the supplements investigated in this study can be expanded to include other supplements regularly used by high school athletes, including prohibited supplements. A focus group discussion will assist to capture qualitative data in order to determine what supplements to include in future research. The focus group discussion will also help to identify the psycological pressures and influences experienced by high school athletes that lead to supplement use in order to excel in competitive sport.

6.2 SUGGESTIONS FOR FUTURE RESEARCH

Future research can build on the current questionnaire to investigate and compare the prevalence and knowledge of and reasons for supplement use in different provinces and countries. Future research could also consider including younger teams to broaden the demographics of adolescents, or expand the current list of supplements investigsted cover a bigger range.

In addition, future research can investigate supplement use over longer periods of time to assess the physical and psychological effects of supplementation on adolescent athletes. Studies like this could also provide information on patterns and trends in supplement use by athletes. Focus

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group discussions can also investigate the phycological reasons and the effect of body image on supplement use in a qualitative study. Supplement intake in relation to a complete diet and periodization can also be investgated.

Moreover, further studies can investigate the correlation between the coaches' personal supplement use and the rugby players' supplement use. The relationship between the players' awareness of fellow teammates' potential supplement usage and their own reported usage can also be investigated.

The ideal is to investigate and use a questionnaire that has gone though thorough validity and reliability testing. An additional study must be conducted to develop a questionnaire whereby all the tools are used to ensure validity and reliability.

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APPENDICES

APPENDIX A

Questionnaire on supplementation in first team high school rugby players in the Western Cape Province

The goal of this survey is to determine the prevalence of supplement use, to determine the knowledge regarding the purpose of supplementation in sport and to assess the reasons for supplement usage by investigating the various influences on rugby players of the first rugby team. Focus will be placed on carbohydrate, protein, creatine and glutamine supplementation.

Thank you for taking the time to complete this questionnaire. Results will be kept anonymous.

Please indicate your answer in the multiple choice questions with an X.

Section 1: Demographic information and training regimen

1.1 Age: _____

1.2 School code: _____

1.3 Area of residence (e.g. Paarl, Bellville): _____

1.4 Rugby position(s): _____

1.5 Preferred rugby position: _____

1.6 Years playing rugby: _____

1.7 Training questions:

1.7.1 How many hours do you play rugby games/compete per week **(excluding training time)**?

1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19+

1.7.2 How many hours do you train per week **(excluding competition/game time)**?

1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19+

OR

	I do not train

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1.7.3 Rate the intensity of your training sessions **(Choose a number between 1-5)**:

1	2	3	4	5

Low intensity Moderate intensity Severe intensity

OR

	I do not train

1.7.4 What kind of training do you do? **(Choose 2 main options)**

	Endurance training (Running long distances 4km+)
	Resistance training (weight, heavy bags, medicinal balls)
	Sprinting
	Ball and game plan training
	Other(please specify)

1.7.5 What other sport do you do? **(Choose 1 main option)**

	Cricket
	Tennis
	Soccer
	Hockey
	Swim
	Other (Please specify)
	I do not do any other sport

1.7.6 Do you go to the gym for physical exercise?

Yes	**No**

1.7.7 What exercises do you do in the gym? **(Choose 1 main option)**

	Cardio exercise (running, spinning etc.)
	Resistance exercise (weight training)
	Aerobics classes
	Other (please specify):
	I do not gym

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Section 2: Supplement usage

1.1 Do you use any of the following supplements**: (Circle your answer)**

Carbohydrates (like Energade, sport drinks, gels, shakes, energy bars):	**Yes**	**No**
Protein (shakes, pills, powders, protein bars, amino acids):	**Yes**	**No**
Creatine (shakes, powders, pills):	**Yes**	**No**
Glutamine (L-glutamine tablets, capsules, powders):	**Yes**	**No**

2.2. Please indicate how often you use the following supplements:

- 2.2.1. Carbohydrates (Energade, sport drinks, gels, shakes, energy bars):

Daily	**4-6 x/week**	**1-3 x/week**	**1-2 x/month**	**Less than monthly**	**Never**

- 2.2.2. Protein (shakes, pills, powders, bars, amino acids):

Daily	**4-6 x/week**	**1-3 x/week**	**1-2 x/month**	**Less than monthly**	**Never**

- 2.2.3. Creatine (shakes, powders, pills):

Daily	**4-6 x/week**	**1-3 x/week**	**1-2 x/month**	**Less than monthly**	**Never**

- 2.2.4. Glutamine (L-glutamine tablets, capsules, powders):

Daily	**4-6 x/week**	**1-3 x/week**	**1-2 x/month**	**Less than monthly**	**Never**

2.3 Dosages/usage

2.3.1. Do you know how many **grams/dosages** of **carbohydrates from supplements** you consume per week?

Yes	No	I do not use carbohydrate supplements

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2.3.2. If **YES**, please state the **amount (in grams) and product name**:

_____

_____

2.3.3. Do you know how many **grams/dosages** of **protein from supplements** you consume per week?

Yes	No	I do not use protein supplements

2.3.4. If **YES**, please state the **amount (in grams) and the product name:**

_____

_____

2.3.5. Do you know how many **grams/dosages** of **creatine from supplements** you consume per week?

Yes	No	I do not use creatine supplements

2.3.6. If **YES**, please state the **amount (in grams) and the product name:**

_____

_____

2.3.7. Do you know how many **grams/dosages of glutamine from supplements** you consume per week?

Yes	No	I do not use glutamine supplements

2.3.8. If **YES**, please state the **amount (in grams) and the product name:**

_____

_____

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2.4 Would you use any of the following supplements in the future?

Carbohydrates (like Energade, sport drinks, gels, shakes, energy bars):	**Yes**	**No**	**Unsure**
Protein (shakes, pills, powders, protein bars, amino acids):	**Yes**	**No**	**Unsure**
Creatine (shakes, powders, pills):	**Yes**	**No**	**Unsure**
Glutamine (L-glutamine tablets, capsules, powders):	**Yes**	**No**	**Unsure**

2.5 Do you know of anyone on your team that uses any of these supplements?

Carbohydrates (like Energade, sport drinks, gels, shakes, energy bars):	**Yes**	**No**
Protein (shakes, pills, powders, protein bars, amino acids):	**Yes**	**No**
Creatine (shakes, powders, pills):	**Yes**	**No**
Glutamine (L-glutamine tablets, capsules, powders):	**Yes**	**No**

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Section 3: Influential factors

3.1 Where do you/ would you get the supplements from? **(Choose 1 answer)**

	School
	Coach
	Pharmacy
	Nutrition supplement store
	Family
	Friends
	Other (please specify):

3.2 Indicate if you agree or disagree with the following statements:

"I feel a great amount of pressure to use supplements in order to perform on the rugby field from…."

3.2.1 **The school:**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.2 **My coach/trainer:**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.3 My **parents/family:**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.4 My **friends: (including teammates)**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.5 **Supplement sponsors:**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.6 **Media: (including magazines, internet, television etc.)**

Strongly agree	Agree	Disagree	Strongly disagree

3.2.7 R**ugby role-models:**

Strongly agree	Agree	Disagree	Strongly disagree

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3.3 **Where do you get your knowledge and information regarding supplementation?**

3.3.1 Indicate from which **ONE individual** you get the **most** knowledge and information regarding supplementation. **(Choose 1)**

	Parents
	Coach
	Friends (including teammates)
	Trainer
	Pharmacist
	Supplement representative
	Dietitian
	Doctor
	Other (please specify):

3.3.2 Indicate from which **ONE form of media** you get the **most** knowledge and information regarding supplementation. **(Choose 1)**

	Magazines
	Internet
	Television
	Other (please specify):

3.3.3	Do you think you need more education regarding supplementation?	Yes	No
3.3.4	Have you ever been to a dietitian regarding your diet and supplement uses?	Yes	No

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Section 4: Reasons for supplement use

4.1 Why use **protein** supplements? (**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to use protein supplements

4.2 Why use **carbohydrate** supplements? (**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to use carbohydrate supplements

4.3 Why use **creatine** supplements? (**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to use creatine supplements

4.4 Why use **glutamine** supplements?(**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to use glutamine supplements

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Section 5: Knowledge

Please read the following questions and answer "true" of "false" to the phrase stated:

1. Taking supplements that are stated "safe" and "tested" cannot harm my health or reputation (false)	**True**	**False**	**Do not know**
2. By reading the label I can know exactly what is in the supplement (false)	**True**	**False**	**Do not know**
3. The protein in supplements is superior to natural protein containing food. (false)	**True**	**False**	**Do not know**
4. High amounts of protein intake cannot do any harm. (false)	**True**	**False**	**Do not know**
5. Carbohydrates help to optimise training and athletic performance. (true)	**True**	**False**	**Do not know**
6. At least 50% of an athlete's total energy intake should come from carbohydrates sources (true)	**True**	**False**	**Do not know**
7. Creatine is proven safe for athletes younger than 18 years. (false)	**True**	**False**	**Do not know**
8. Creatine makes you gain muscle mass (false: it makes you gain water mass)	**True**	**False**	**Do not know**
9. Glutamine supplementation is proven to help with prevention of muscle breakdown (false)	**True**	**False**	**Do not know**
10. Glutamine helps with recovery after training (false)	**True**	**False**	**Do not know**
11. Too much protein can lead to dehydration (true)	**True**	**False**	**Do not know**
12. Using supplements is the only way to build muscles (false)	**True**	**False**	**Do not know**
13. Creatine is also found in animal protein like meat and poultry. (true)	**True**	**False**	**Do not know**
14. Carbohydrates assist with recovery after exercise (true)	**True**	**False**	**Do not know**
15. Glutamine supplementation is apparently not effective (true)	**True**	**False**	**Do not know**

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APPENDIX B

Questionnaire on supplementation in first team high school coaches in the Western Cape Province (coaches/trainers)

The goal of this survey is to determine the prevalence of supplement use, to determine the knowledge regarding the purpose of supplementation in sport and to assess the reasons for supplement use by investigating the various influences on rugby players of the first team rugby team. Focus will be placed on carbohydrate, protein, creatine and glutamine supplementation.

Thank you for taking the time to complete this questionnaire. Results will be kept anonymous.

Please indicate your answer in the multiple choice questions with an X.

Section 1: Demographic information and training regimen

1.1 What is your title: (e.g. coach/ trainer) _____

1.2 Years coaching/training (overall): _____

1.3 Years coaching/training rugby specifically: _____

1.4 School code: _____

1.5 Training questions:

1.5.1 How many hours do you train per week?

1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19+

OR

	I do not train

1.5.2 Rate the intensity of your training sessions **(Choose a number between 1-5)**:

1	2	3	4	5

Low intensity Moderate intensity Severe intensity

OR

	I do not train

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1.5.3 What kind of training do you do? **(Choose 1 main options)**

	Endurance training (Running long distances 4km+)
	Resistance training (weight, heavy bags, medicinal balls)
	Sprinting
	Ball and game plan training
	Other(please specify)

1.5.4 What other sport do you do? (**Choose 1 main option)**

	Cricket
	Tennis
	Soccer
	Hockey
	Swim
	Other (Please specify)
	I do not do any other sport

1.5.5 Do you go to the gym for physical exercise?

Yes	**No**

1.5.6 What exercises do you do in the gym? **(Choose 1 main option)**

	Cardio exercise (running, spinning etc.)
	Resistance exercise (weight training)
	Aerobics classes
	Other (please specify):
	I do not gym

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Section 2: Supplement promotion

2.1 Do you use any of the following supplements**:**

Carbohydrates (like Energade, sport drinks, gels, shakes, energy bars):	**Yes**	**No**
Protein (shakes, pills, powders, protein bars, amino acids):	**Yes**	**No**
Creatine (shakes, powders, pills):	**Yes**	**No**
Glutamine (L-glutamine tablets, capsules, powders):	**Yes**	**No**

2.2 Do you encourage your rugby players to use any of these supplements?

Carbohydrates (like Energade, sport drinks, gels, shakes, energy bars):	**Yes**	**No**
Protein (shakes, pills, powders, protein bars, amino acids):	**Yes**	**No**
Creatine (shakes, powders, pills):	**Yes**	**No**
Glutamine (L-glutamine tablets, capsules, powders):	**Yes**	**No**

2.3 If you stated **YES** to any of the abovementioned supplements please state why do you encourage these supplements? **(choose 1 main reason)**

	To improve the team's overall performance
	To make them better rugby players
	To increase their strength/muscle mass
	To improve their health
	To make the team stronger than the other rugby teams
	Other reason (please specify):

2.4 Why do you encourage the use of **protein** supplements?(**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to advice the use of protein supplements

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2.5 Why do you encourage the use of **carbohydrate** supplements?(**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to advice the use of carbohydrate supplements

2.6 Why do you encourage the use of **creatine** supplements?(**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to advice the use of creatine supplements

2.7 Why do you encourage the use of **glutamin**e supplements?(**Choose 1 main answer**)

	To increase muscle mass/strength
	To increase speed
	To increase muscle recovery
	To reduce fatigue/ increase energy
	To prevent dehydration
	Other reason (please specify):
	I do not want to advice the use of glutamine supplements

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Section 3: Nutrition training

3.1 Have you received any training or education regarding nutrition and supplementation?

Yes	**No**

3.2 If you answered **YES**, please specify:

3.2.1 **Where** have you received your nutrition and supplement training?

_____

3.2.2 What nutrition **topics** did this training cover?

_____

3.2.4 How **many hours/days/years** was this training?

_____

3.3 Do you think it is **ethical** for trainers/coaches to provide adolescent rugby players with supplements?

Yes	**No**

3.4 **Where do you get your knowledge and information regarding supplementation?**

3.4.1 Indicate from which **ONE individual** you get the **most** knowledge and information regarding supplementation. **(Choose 1)**

	Parents
	Coach
	Friends
	Trainer
	Pharmacist
	Supplement representative
	Dietitian
	Doctor
	Other (please specify):

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3.4.2 Indicate from which **ONE form of media** you get the **most** knowledge and information regarding supplementation. **(Choose 1)**

	Magazines
	Internet
	Television
	Other (please specify):

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Section 4: Knowledge

1. Taking supplements that are stated "safe" and "tested" cannot harm my health or reputation (false)	**True**	**False**	**Do not know**
2. By reading the label I can know exactly what is in the supplement (false)	**True**	**False**	**Do not know**
3. The protein in supplements is superior to natural protein containing food (false)	**True**	**False**	**Do not know**
4. High amounts of protein intake cannot do any harm (false)	**True**	**False**	**Do not know**
5. Carbohydrates help to optimise training and athletic performance (true)	**True**	**False**	**Do not know**
6. At least 50% of an athlete's total energy intake should come from carbohydrate sources (true)	**True**	**False**	**Do not know**
7. Creatine is proven safe for athletes younger than 18 years (false)	**True**	**False**	**Do not know**
8. Creatine makes you gain muscle mass (false: it makes you gain water mass)	**True**	**False**	**Do not know**
9. Glutamine supplementation is proven to help with prevention of muscle breakdown (false)	**True**	**False**	**Do not know**
10. Glutamine helps with recovery after training (false)	**True**	**False**	**Do not know**
11. Too much protein can lead to dehydration (true)	**True**	**False**	**Do not know**
12. Using supplements is the only way to build muscles (false)	**True**	**False**	**Do not know**
13. Creatine is also found in animal protein like meat and poultry (true)	**True**	**False**	**Do not know**
14. Carbohydrates assist with recovery after exercise (true)	**True**	**False**	**Do not know**
15. Glutamine supplementation is apparently not effective (true)	**True**	**False**	**Do not know**

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APPENDIX C

Standard Operating Procedure (SOP)

Data collection from rugby players and coaches

On the day of data collection the following procedures need to be communicated to the fieldworker and the participants:

- Informed consent forms will be given to the selected schools, students and coaches. Schools and coaches that gave informed consent will take part in this study. Students below the age of 18 years will be asked to take the informed consent forms home for their parents / guardians to sign. In case students stay in the residence and are not able to go home and ask permission from their parents, the parents' email addresses or contact numbers will be obtained and informed consent will be sought from them electronically.
- The following day / week, the fieldworker will return to the school and collect all informed consent documents.
- Participants, including those whose parents provided consent for them to participate in the study, will gather in a classroom allocated by the school.
- Study participants will be seated with enough space between them so they would not be able to see each other's questionnaires.
- Study participants will not be allowed to talk to each other during the completion of the questionnaire.
- The fieldworker will hand out each questionnaire upside down and a pen to the study participants (coaches and rugby players will receive different questionnaires).
- Each questionnaire will be coded to help with filing, identification and anonymity. Each school will receive an A or B for the league it is in.
- Each student and coach will be assigned a participant number. For example, the first participant from a school was assigned the number 1 and if this participant played League A rugby, his code would be 1A. The coaches received an additional C at the end of their code. For example, coach 1 from League B would be coded 1BC.

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- When the fieldworker is done handing out the questionnaires, he/she will indicate when the study participants can turn the questionnaires around and start answering the questions.
- Each participant that has finished completing the questionnaire can stay seated and the fieldworker will go to each participant and collect each questionnaire and pen.
- The fieldworker will check the questionnaire for completeness and file it correctly.
- Questionnaires will be filed according to Premier A and B league schools' different boxes.
- After data collection is completed, participants will gather to watch the educational presentation regarding supplementation and healthy lifestyle during adolescence.

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APPENDIX D

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Approval Notice
Response to Modifications- (New Application)

20-Oct-2014
Jooste, Michelle M

Ethics Reference #: S14/05/110

Title: **Prevalance, knowledge and reasons for use of carbohydrate, protein, creatine and glutamine supplements among first team rugby players in premier rugby schools in the Western Cape Province.**

Dear Ms Michelle Jooste,

The Response to Modifications - *(New Application)* received on 03-Oct-2014, was reviewed by members of Health Research Ethics Committee 2 via Expedited review procedures on 17-Oct-3014 and was approved.
Please note the following information about your approved research protocol:

Protocol Approval Period: 17-Oct-2014 -17-Oct-2015

Please remember to use your **protocol number** (S14/05/110) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:
Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.
Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

If you have any questions or need further assistance, please contact the HREC office at 0219389207.

Included Documents:
HREC New application form
Investigator CV (Havemann-Nel)
HREC checklist

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APPENDIX E

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20150109-41909
ENQUIRIES: Dr A T Wyngaard

Ms Michelle Jooste
13 Regency Crescent
Leopard Rock Estate
Plattekloof
7500

Dear Ms Michelle Jooste

RESEARCH PROPOSAL: PREVALENCE, KNOWLEDGE AND REASONS FOR USE OF CARBOHYDRATE, PROTEIN, CREATINE AND GLUTAMINE SUPPLEMENTS AMONG FIRST TEAM RUGBY PLAYERS IN PREMIER RUGBY SCHOOLS IN THE WESTERN CAPE PROVINCE

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **26 January 2015 till 27 February 2015**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 09 January 2015

Lower Parliament Street, Cape Town, 8001
tel: +27 21 467 9272 fax: 0865902282
Safe Schools: 0800 45 46 47

Private Bag X9114, Cape Town, 8000
Employment and salary enquiries: 0861 92 33 22
www.westerncape.gov.za

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APPENDIX F

Participant information leaflet and consent form: school

TITLE OF THE RESEARCH PROJECT:

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

PRINCIPAL INVESTIGATOR: Michelle Jooste

CONTACT NUMBER: 083 454 2652

Your school is invited to take part in a research study. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how your child could be involved. Also, you participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you or your school negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

The main aim of this study is to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine supplement use among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa.

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Reasons for the study:

1. to determine the prevalence of carbohydrate, protein, creatine and glutamine usage among adolescent rugby players;
2. to determine the rugby players' knowledge regarding the use of supplements;
3. to determine the rugby players' motivation (influences and reasons) for the use of supplements;
4. to determine if their knowledge towards supplements has an influence on their use of supplements;
5. to compare the above mentioned parameters between rugby players playing in premier A versus premier B high schools;
6. to determine the prior training, current knowledge and prescriptive behaviour of coaching staff to their adolescent rugby players regarding supplementation.

- You will gather in a classroom at the school where you will complete a questionnaire. Questions include:
  - Which of the selected supplements do you use?
  - Why do you use these products?
  - Where do you get information regarding these supplements?
- An **informative and educational presentation** regarding optimal health and supplementation to optimise your sport / rugby performance will be given to you.

Why have you been invited to participate?

- Your school has been invited to take part in this study, because you are in the Premier A or B rugby league in the Western Cape Province.

What will your responsibilities be?

- To complete the consent form to permit your school to participate in the study.

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Will you benefit from taking part in this research?

- There are no DIRECT benefits to the participants who take part in this study, but hopefully the **educational presentation** will help the coaches, athletes and your school to see the importance of a healthy lifestyle, especially during adolescence.

Are there risks involved in taking part in this research?

- There are no risks involved in taking part in this study seeing that they are only required to complete a simple questionnaire. There will also be no consequences for the players, coaches or parents / guardians, should the use of performance enhancing supplements be acknowledge. Individuals from separate schools do not risk being identified should a situation arise where pressure is placed on learners.

If you do not agree to take part, what alternatives do you have?

- Participation in the study is completely voluntary, and if you do not wish to participate do not provide informed consent, you can return the uncompleted consent form and you will not be included in the study.

Who will have access to the completed questionnaires?

- Your school's questionnaire will be completed anonymously and will be collected by the investigator. Personnel from Stellenbosch University will read and assess the data, but the questionnaire and the results will have no form of identification available.

Will participants in this study be paid to take part and are there any costs involved?

- No one will be paid to take part in this study.

Is there anything else that you should know or do?

- You may contact the Health Research Ethics Committee on telephone 021 938 9207 should you have any concerns or complaints that have not been adequately addressed by your study researcher.
- You will receive a copy of this information and consent form for your own records.

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Declaration by participant

By signing below, I ……..……. agree that my school…….can take part in a research study entitled:
An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (place) .....…..…….. on (date) ……...…….. 2014

....

Signature of participant **Signature of witness**

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Declaration by investigator

I (name) ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.)

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of investigator **Signature of witness**

Declaration by interpreter

I (name) ……..…… declare that:

- I assisted the investigator (name) ……. to explain the information in this document to (name of participant) ……..…….. using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (place) .....…..…….. on (date) ……...……..

....

Signature of interpreter **Signature of witness**

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APPENDIX G

Participant information leaflet and consent form: parents / guardians

TITLE OF THE RESEARCH PROJECT

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

PRINCIPAL INVESTIGATOR: Michelle Jooste

CONTACT NUMBER: 083 454 2652

Your child is invited to take part in a research study. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you and your son are fully satisfied that you clearly understand what this research entails and how your child could be involved. Also, your child's participation is **entirely voluntary** and he is free to decline to participate. If he says no, this will not affect him negatively in any way whatsoever. He is also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

The main aim of this study is to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine supplement use among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa.

Reasons for the study

1. to determine the prevalence of carbohydrate, protein, creatine and glutamine usage among adolescent rugby players;

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2. to determine the rugby players' knowledge regarding the use of supplements;
3. to determine the rugby players' motivation (influences and reasons) for the use of supplements;
4. to determine if their knowledge towards supplements has an influence on their use of supplements;
5. to compare the above mentioned parameters between rugby players playing in premier A versus premier B high schools;
6. to determine the prior training, current knowledge and prescriptive behaviour of coaching staff towards their adolescent rugby players regarding supplementation.

- An **informative and educational presentation** regarding optimal health and supplementation to optimise your sport / rugby performance will be given to the participants.

Why has your son been invited to participate?

- Your son has been invited to take part of this study because he plays or is a reserve for his school's first rugby team and he complies with the inclusion criteria of this study.

What will your responsibilities be?

- To complete the consent form to permit your son to participate in the study and to ensure that your son is at school on the day the study is conducted and the questionnaire needs to be completed.

Will you benefit from taking part in this research?

- There are no DIRECT benefits to the participants that take part in this study, but hopefully the **educational presentation** will help these athletes and the school to see the importance of a healthy lifestyle, especially during adolescence.

Are there risks involved in taking part in this research?

- There are no risks involved in taking part in this study seeing that he is only required to complete a simple questionnaire. There will also be no consequences for the players, coaches or parents / guardians, should the use of performance enhancing supplements be acknowledge. Individuals from separate schools do not risk being identified should a situation arise where pressure is placed on learners.

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If you do not agree to take part, what alternatives do you have?

- Participation in the study is completely voluntary, and if you do not wish for your son to participate, you can return the uncompleted consent form and you will not be included in the study.

Who will have access to his completed questionnaire?

- Your son's questionnaire will be completed anonymously and will be collected by the investigator. Personnel from Stellenbosch University will read and assess his data, but the questionnaire and the results will have no form of identification available.

Will participants in this study be paid to take part and are there any costs involved?

- No one will be paid to take part in this study. Parents / guardians will also not be paid should their son take part in this study.

Is there anything else that you should know or do?

- You may contact the Health Research Ethics Committee on telephone 021 938 9207 should you have any concerns or complaints that have not been adequately addressed by your study researcher.
- You will receive a copy of this information and consent form for your own records.

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Declaration by participant

By signing below, I ……..……. agree that my son, …… can take part in a research study entitled:

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of participant **Signature of witness**

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Declaration by investigator

I (name) ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.)

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of investigator **Signature of witness**

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Declaration by interpreter

I (name) ……..…… declare that:

- I assisted the investigator (name) ……. to explain the information in this document to (name of participant) ……..…….. using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (place) .....….....…….. on (date) ……...……..

....

Signature of interpreter **Signature of witness**

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APPENDIX H

Participant information leaflet and consent form: coaches

TITLE OF THE RESEARCH PROJECT

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

PRINCIPAL INVESTIGATOR: Michelle Jooste

CONTACT NUMBER: 083 454 2652

You are invited to take part in a research study. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

The main aim of this study is to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine supplement use among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa.

Reasons for the study:

1. to determine the prevalence of carbohydrate, protein, creatine and glutamine usage among adolescent rugby players;
2. to determine the rugby players' knowledge regarding the use of supplements;

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3. to determine the rugby players' motivation (influences and reasons) for the use of supplements;
4. to determine if their knowledge towards supplements has an influence on their use of supplements;
5. to compare the above mentioned parameters between rugby players playing in premier A versus premier B high schools;
6. to determine the prior training, current knowledge and prescriptive behaviour of coaching staff to their adolescent rugby players regarding supplementation.

- The coaches and rugby team members will gather in a classroom at the school where they will complete a questionnaire. Questions include:
    - Which of the selected supplements do you promote?
    - Why do you promote these products?
    - What do you know about the purpose of these supplements?
    - Where do you get information regarding these supplements?
- An **informative and educational presentation** regarding optimal health and supplementation will be given to the rugby players and coaches that take part in this study.

Why have you been invited to participate?

You have been invited to take part of this study, because you are a coach for the school's first rugby team and comply with the inclusion criteria of this study.

Inclusion criteria:

- Coaches from selected schools
- Coaches that coach first team rugby players

What will your responsibilities be?

- To complete the consent form to permit you to participate in the study and to ensure that you are at school on the day the study is conducted and the questionnaire needs to be completed.
- Thereafter you will be asked to complete a questionnaire regarding supplement usage.

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- If you wish, you can stay and listen to an informative and educational presentation regarding optimal health and supplement use to optimise sport / rugby performance.

Will you benefit from taking part in this research?

- There are no DIRECT benefits to the participants that take part in this study, but hopefully the **educational presentation** will help you, your athletes and the school to see the importance of a healthy lifestyle - especially during adolescence.

Are there risks involved in taking part in this research?

- There are no risks involved in taking part in this study seeing that you are only required to complete a simple questionnaire. There will also be no consequences for the players, coaches or parents / guardians, should the use of performance enhancing supplements be acknowledge. Individuals from separate schools do not risk being identified should a situation arise where pressure is placed on learners.

If you do not agree to take part, what alternatives do you have?

- Participation in the study is completely voluntary and if you do not wish to participate, you can return the uncompleted consent form and you will not be included in the study.

Who will have access to his completed questionnaire?

- Your questionnaire will be completed anonymously and will be collected by the investigator. Personnel from Stellenbosch University will read and assess the data, but the questionnaire and the results will have no form of identification available.

Will participants in this study be paid to take part and are there any costs involved?

- No one will be paid to take part in this study.

Is there anything else that you should know or do?

- You may contact the Health Research Ethics Committee on telephone 021 938 9207 should you have any concerns or complaints that have not been adequately addressed by your study researcher.
- You will receive a copy of this information and consent form for your own records.

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Declaration by participant

By signing below, I ……..……. agree to take part in a research study entitled:

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of participant **Signature of witness**

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Declaration by investigator

I (name) ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.)

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of investigator **Signature of witness**

Declaration by interpreter

I (name) ……..…… declare that:

- I assisted the investigator (name) ……. to explain the information in this document to (name of participant) ……..…….. using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (place) .....…..…….. on (date) ……...……..

....

Signature of interpreter **Signature of witness**

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APPENDIX I

Participant information leaflet and consent form: rugby players

TITLE OF THE RESEARCH PROJECT:

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

PRINCIPAL INVESTIGATOR: Michelle Jooste

CONTACT NUMBER: 083 454 2652

You are invited to take part in a research study. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

The main aim of this study is to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine supplement use among adolescent male rugby players from premier A and B league schools in the Western Cape, South Africa.

Reasons for the study:

1. to determine the prevalence of carbohydrate, protein, creatine and glutamine usage among adolescent rugby players;
2. to determine the rugby players' knowledge regarding the use of supplements;

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3. to determine the rugby players' motivation (influences and reasons) for the use of supplements;
4. to determine if their knowledge towards supplements has an influence on their use of supplements;
5. to compare the above mentioned parameters between rugby players playing in premier A versus premier B high schools;
6. to determine the prior training, current knowledge and prescriptive behaviour of coaching staff towards their adolescent rugby players regarding supplementation.

- You will gather in a classroom at the school where you will complete a questionnaire. Questions include:
    - Which of the selected supplements do you use?
    - Why do you use these products?
    - Where do you get information regarding these supplements?
- An **informative and educational presentation** regarding optimal health and supplementation to optimise your sport / rugby performance will be given to you.

Why have you been invited to participate?

You have been invited to take part in this study, because you play or you are a reserve for your school's first rugby team and comply with the inclusion criteria of this study.

Inclusion criteria:

- All first team rugby players and the reserves from the premier A and B league rugby schools in the Western Cape.
- Male rugby players
- The study sample is not restricted to age or ethnic group.

What will your responsibilities be?

- You will be asked to take the consent form home for your parents to sign, and then also complete the consent form to permit you to participate in the study and to ensure that you are at school on the day the study is conducted and the questionnaire needs to be completed.

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- Thereafter you will be asked to complete a questionnaire regarding your supplement usage.
- If you wish, you can stay and listen to an informative and educational presentation regarding optimal health and supplement use to optimise sport / rugby performance.

Will you benefit from taking part in this research?

- There are no DIRECT benefits to the participants who take part in this study, but hopefully the **educational presentation** will help you as an athlete and your school to see the importance of a healthy lifestyle, especially during adolescence.

Are there risks involved in taking part in this research?

- There are no risks involved in taking part in this study, seeing that you are only required to complete a simple questionnaire. There will also not be any consequences for the players, coaches or parents / guardians, should the use of performance enhancing supplements be acknowledge. Individuals from separate schools do not risk being identified should a situation arise where pressure is placed on learners.

If you do not agree to take part, what alternatives do you have?

- Participation in the study is completely voluntary and if you do not wish to participate or if your parents / guardians do not provide informed consent, you can return the uncompleted consent form and you will not be included in the study.

Who will have access to your completed questionnaire?

- Your questionnaire will be completed anonymously and will be collected by the investigator. Personnel from Stellenbosch University will read and assess the data, but the questionnaire and the results will have no form of identification available.

Will participants in this study be paid to take part and are there any costs involved?

- No one will be paid to take part in this study.

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Is there anything else that you should know or do?

- You may contact the Health Research Ethics Committee on telephone 021 938 9207 should you have any concerns or complaints that have not been adequately addressed by your study researcher.
- You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I ……..……. agree to take part in a research study entitled:

An assessment to determine the prevalence, knowledge and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province.

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests or if I do not follow the study plan as agreed to.

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

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....

Signature of participant **Signature of witness**

Declaration by investigator

I (name) ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.)

Signed at (place) .....…..…….. on (date) ……...…….. 2014.

....

Signature of investigator **Signature of witness**

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Declaration by interpreter

I (name) ……..…… declare that:

- I assisted the investigator (name) ……. to explain the information in this document to (name of participant) ……..…….. using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (place) .....….....…….. on (date) ……...……..

....

Signature of interpreter **Signature of witness**

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APPENDIX J

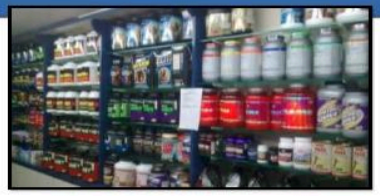
michellejooste
dietician

Misconceptions...

1. 'I need to use supplements to perform better...'
2. 'my diet cannot provide the same benefits...'
3. 'there is no nutritional value in today's food...'
4. 'I need it to make up for poor diet and lack of training...'
5. 'It is the only way to build muscle...'
6. It is natural, safe and legal...it cannot do any harm'
7. 'Supplements bought or provided by a well-known store, pharmacy, website, supplement company / sales representative, must be safe and legal'

WHAT YOU NEED TO KNOW

The supplement label does not guarantee safety



- Supplement companies do **not need to test and prove** that their products are effective, pure or safe
- Products may be **sold with misleading claims, incorrect labelling and lack of scientific and safety evidence**
- Products are only removed / banned from the market once a **critical number of serious ill health or injury** reports are received
- Supplement companies may quote or reference 'scientific' evidence, but at closer look the **evidence may be insufficient, irrelevant, misinterpreted, not applicable to youth, or in the worst, fabricated.**

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WHAT YOU NEED TO KNOW

Alarming increase in reports of damaging health effects and positive doping tests (SA)

HEALTH RISK

- Allergic Reactions
- Toxic Effects of Self-Medicating
- Overdosing
- Poisoning due to contaminants found in products
- Positive testing that can ruin your sporting career
- Discredit your reputation
- And that of your country

Supplements commonly used

Protein Shakes

Supplements commonly used

Protein Shakes

- Protein in supplements is not superior compared to what is found in food
- With an optimal diet it is easy to meet protein requirements
- Optimising diet is a prerequisite before protein supplement is considered

Risks:

- Dehydration
- Increased stressed on liver and kidneys
- At the expense of CHO (Less energy for growth and development)
- Increased fat mass

Protein should not be used unless a specific deficiency is identified

Supplements commonly used

Creatine

Supplements commonly used

Creatine

- Source of fuel stored within the body that provides energy at a very fast rate
- The body produces its own creatine
- You can get it from eating animal protein (meat, poultry, fish)
- It is more that sufficient to meet the body's requirements

Potential Risk:

- In select cases – it is proven to be ineffective and unsafe in youth
- American College of Sport Medicine (ADSM) creatine should not be used in <18 year youth due to the unknown potential health effects.

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Supplements commonly used

Carbohydrates

Supplements commonly used

Carbohydrates

- CHO are very important to optimal diet and maximum training and performance
- CHO greatest supplement thus far
- Provides assistance in recovery
- CHO should come from wholesome Low to moderate GI foods
- Vitamins , minerals and dietary fibre

Risks:
- Refined CHO (sport drinks, gels, bars) is useful, although there is a concern that it could cause obesity and dental problems

Supplements commonly used

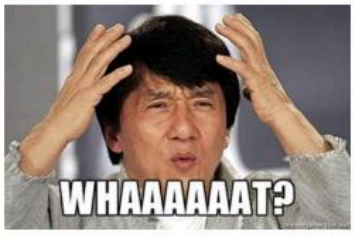
Glutamine

Supplements commonly used

Glutamine

- Generally glutamine is seen as fairly safe, but not recommended for individuals with kidney problems
- Consuming the **right amount of protein** is very important, but the intake of glutamine supplements is **not essential**
- **Evidence up to date does not support a recommendation for an athlete to use a glutamine supplement.**
- Primary studies did indicate that glutamine can inhibit the deterioration or even enhance glutamine concentration during training
- **And latest studies indicate that that the only benefit glutamine provides is to athletes that have a true glutamine deficiency**

So what now?



Fundamentals of a successful athletes

Rest/ Sleep

Training ⟷ Nutrition

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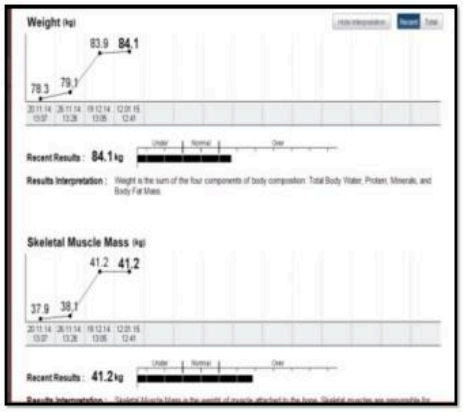


Before – During - After

Before example:

Before Rugby Game

- Sandwich (2 slices) + jam + banana + 500ml Energade OR
- 1 Cup oats + 2 teaspoons sugar + sandwich with jam + ½ cup fruit juice

Before strength exercise

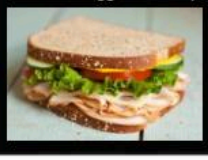
- 1 sandwich with jam and peanut butter + sandwich with scramble egg + 1 cup fruit juice OR
- 1 cup ProNutro/ Futurelife + 1 cup fat free milk + 1 banana + 1 cup coffee/ tea with milk and 2 teaspoons sugar

During example:

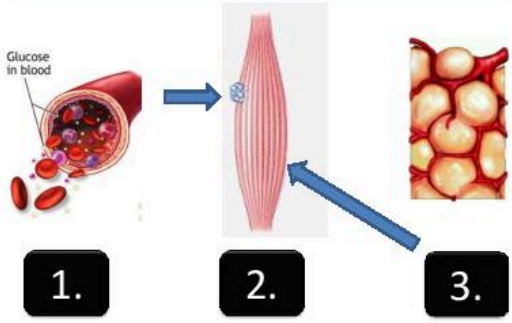
- 500ml Energade/ Powergade/ Game
- 1 Jungle Oats bar
- 6 Jelly Beans
- 2 medium bananas
- 1 sandwich

After example:

- 1 Steri Stumpie
- 500ml Energade + 50g lean biltong
- Sandwich with ham and cheese + 175ml yoghurt + 1 medium banana
- 2 Slices of toast with scramble egg + 175ml yoghurt + 1 cup fruit juice



Energy Systems



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APPENDIX K

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Language editing

I hereby confirm that I have edited Michelle Jooste's Master's thesis titled *An assessment to determine the prevalence and knowledge of and reasons for carbohydrate, protein, creatine and glutamine use among first team rugby players in premier rugby schools in the Western Cape Province*. Harvard editing standards and Vancouver referencing standards have been applied.

Amanda Matthee

Teksskrywer, vertaler en taalversorger
Text writer, translator and editor

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